Series 1930 Number 24

UNITED STATES DEPARTMENT OF AGRICULTURE

# Soil Survey
of
# Tillman County, Oklahoma

By

A. W. GOKE, in Charge, and E. G. FITZPATRICK
United States Department of Agriculture
and
W. C. BOATRIGHT
Oklahoma Agricultural Experiment Station

## Bureau of Chemistry and Soils

In cooperation with the
Oklahoma Agricultural Experiment Station

For sale by the Superintendent of Documents, Washington, D.C. - - - - - - - - - Price 35 cents

## BUREAU OF CHEMISTRY AND SOILS

HENRY G. KNIGHT, *Chief*
A. G. McCALL, *Chief, Soil Investigations*
SYDNEY FRISSELL, *Editor in Chief*

SOIL SURVEY

CURTIS F. MARBUT, *in Charge*
W. T. CARTER, *Acting Inspector, District 4*
J. W. McKERICHER, *in Charge Map Drafting*

COOPERATION

OKLAHOMA AGRICULTURAL EXPERIMENT STATION

C. P. BLACKWELL, *Director*

AGRONOMY DEPARTMENT

N. E. WINTERS, *Head of Department*


### CONTENTS

# SOIL SURVEY OF TILLMAN COUNTY, OKLAHOMA

By A. W. GOKE, in Charge, and E. G. FITZPATRICK, United States Department of Agriculture, and W. C. BOATRIGHT, Oklahoma Agricultural Experiment Station

## COUNTY SURVEYED

Tillman County is in southwestern Oklahoma (fig. 1). It is bordered on the west by North Fork Red River and on the south by Red River which forms the boundary between Oklahoma and Texas. The total area of the county is 900 square miles, or 576,000 acres.

The area enclosed within the boundaries of Tillman County is part of a plain sloping slightly southward. A belt, reaching a maximum width of 10 miles, lying along the western side of the county, west of a north-south line slightly west of the St. Louis-San Francisco Railway, has a rolling undissected constructional relief formed by deposits of wind-blown sandy material. East of that line the relief forms are everywhere, except in a belt along the southern part of the county, destructional, having been formed by the rather complete but shallow dissection of the widely branching drainage system of Deep Red Creek. The northeastern part of the county, being the highest part of the dissected eastern portion, is the most thoroughly and most deeply dissected.

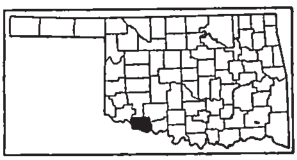


FIGURE 1.—Sketch map showing location of Tillman County, Okla.

In the dissected part, the shales and fine-grained sandstones of the Permian[1] series constitute the underlying rocks, and the soils have developed mainly, if not entirely, from the products of their decay. These "Red Beds", unlike the sandy material in other parts of the county do not readily absorb the rainfall and, therefore, erode very easily, so that most of the surface is cut by drainage channels and reduced to slopes. The surface modification over the western and extreme southern parts of the county has been accomplished chiefly through wind erosion which has shifted the sandy material over the surface and piled it into dunes or low mounds, so that the original level surface has been changed to a smoothly undulating or gently rolling surface with very little relief.

The absence of stream erosion over the western and extreme southern parts of the county has resulted in those areas retaining most of their original surface elevation; but in the northeastern half, erosion has lowered the surface level considerably. Geologists believe that the original surface level of the northeastern part of the county was at a higher elevation than that of the western and southern parts, and that at that time the western portion was part of an ancient river bed. However, the removal of a large part of the surface material in the eastern part of the county and the shifting of Red River toward the west to a lower elevation, as a result of stream erosion, has brought the surface of the supposed ancient river bed to an elevation that is almost as high as that of the northeastern part of the county.

[1] CLIFTON, R. L. HARMON, GREER, JACKSON, AND TILLMAN COUNTIES. Okla. Geol. Survey Bull. 40, v. 3, pp. 206-210. 1930.

The valleys of Red River and of North Fork Red River consist of flat-bottomed winding trenches with sloping walls extending into the uplands. The river channels consist chiefly of beds of loose sand without vegetation, more than a mile in width, along which the rivers run, except when in flood, in a series of interlacing channels. Only 1 very small stream is tributary to North Fork Red River in the western part of the county and 5 or 6 small ones are tributary to Red River along the southern part.

The elevation [2] at Frederick, near the center of the county, is 1,293 feet above sea level and at Davidson, in the southwestern part, is 1,165 feet.

The prevalent type of vegetation before the county was settled consisted of short grasses, such as buffalo, grama, and wire grass, and mesquite trees; but in places this type of vegetation was modified by the taller grasses—the andropogons. The latter usually were dominant over the eroded and sandy sections. The native trees were confined chiefly to the valleys and included elm, hackberry, cottonwood, ash, chittam, haw, and pecan.

Tillman County was organized from part of Comanche County in 1907, and part of Kiowa County was annexed in 1911. Before the organization of the county, most of the land was used for grazing purposes by ranchers who owned large herds of cattle, but after its organization the land was taken up by settlers, most of whom came from Nebraska, Texas, Iowa, Missouri, Ohio, Illinois, Indiana, and Arkansas. No part of the county has been settled exclusively by colonists of foreign extraction.

The population in 1930 was 24,390, of which 19,822 were classed as rural. Of the rural population, 14,235 were classed as rural farm, and 5,587 as rural nonfarm. The rural population is fairly evenly distributed, the most thinly populated section being near the Red River Valley in the southern part of the county. The population is preponderantly white. Most of the 3,000 Negroes are congregated in the larger towns.

Most of the towns are so located that the different parts of the county are conveniently served. Frederick, the largest town, with a population of 4,568, is located near the center of the county and is the county seat. Grandfield, in the southeastern part, with a population of 1,416; Tipton, in the northwestern part, with 1,459; Davidson, in the southwestern part, with 572; Hollister, in the central part, with 198; Manitou, in the northern part, with 323; and Loveland, in the southeastern part, with 106, are smaller trading centers. These towns are connected by railways and by county roads.

Public roads extend along most of the section lines. Most of the roads are of dirt construction; but they are kept in fairly good repair, except during protracted rainy seasons, when they sometimes become too muddy for automobile travel. Only a few miles of the main roads are surfaced with gravel. Telephone service and rural mail delivery reach most of the rural homes. The rural schools are fairly well equipped. In most sections the rural districts have consolidated and have built 3- or 4-room schoolhouses with equipment to teach the higher branches of education. Only a few rural churches are in the county.

Cotton, wheat, and a few cattle are the principal farm products sold to outside markets.

---

[2] GANNETT, H A DICTIONARY OF ALTITUDES IN THE UNITED STATES. U S Geol. Survey Bull 274, ed. 1,072 pp 1906.

## CLIMATE

The growing season is long enough for maturing all crops commonly grown. Climatic conditions are also favorable for the cultivation and harvesting of crops. The average length of the frost-free season is 226 days, from March 27 to November 8. The date of the latest killing frost on record is April 25 and of the earliest is October 19.

Cultivation and harvesting of crops are very seldom delayed to any extent because of rainy or cloudy weather. Periods of inclement weather during the growing season are usually of only 1- or 2-day's duration. Considerable field work can be done during the non-growing season. In 1930 the farmers were preparing land for cotton and oats in February and March. Field work is usually suspended during January and February, when most of the cold and disagreeable weather of the year ordinarily prevails.

The winter seasons are in general mild with southerly winds, alternating with short periods of low temperature and northerly winds. The winter seasons are characterized by a predominance of sunshiny days, the average rainfall at this time being 3.49 inches, an amount considerably less than the average during any other season of the year. Snowfalls are light, snow ordinarily remaining on the ground a very short time. However, during the winter of 1930, snow covered the ground throughout the greater part of January. Ordinarily, most of the winter precipitation occurs during December.

The average annual rainfall is 26.95 inches. Dashing rains that resemble cloudbursts usually occur during the spring, sometimes as much as 4 inches of rain falling within a very short time. Such storms are often accompanied by hail.

Table 1 gives the normal monthly, seasonal, and annual temperature and precipitation at Frederick, and the data are considered representative of the climate of the county as a whole.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Frederick, Tillman County, Okla.*

[Elevation, 1,293 feet]

| Month | Temperature | | | Precipitation | | | |
|---|---|---|---|---|---|---|---|
| | Mean | Absolute maximum | Absolute minimum | Mean | Total amount for the driest year (1910) | Total amount for the wettest year (1920) | Snow, average depth |
| | ° F | ° F | ° F. | Inches | Inches | Inches | Inches |
| December | 41.6 | 79 | 0 | 1.44 | 0.40 | 0.25 | 2.3 |
| January | 40.6 | 90 | −8 | 1.00 | .69 | 2.22 | 1.3 |
| February | 45.5 | 93 | 4 | 1.05 | .16 | .64 | .8 |
| Winter | 42.6 | 93 | −8 | 3.49 | 1.25 | 3.11 | 4.4 |
| March | 53.8 | 98 | 11 | 1.69 | .72 | 1.17 | .9 |
| April | 62.3 | 98 | 24 | 3.10 | 1.01 | 5.31 | .0 |
| May | 70.7 | 106 | 35 | 3.93 | 2.47 | 5.26 | .0 |
| Spring | 62.3 | 106 | 11 | 8.72 | 4.20 | 11.74 | .9 |
| June | 79.5 | 111 | 43 | 2.42 | 2.02 | 2.33 | .0 |
| July | 83.6 | 112 | 56 | 2.30 | 1.27 | 3.24 | .0 |
| August | 83.2 | 109 | 48 | 2.14 | 2.46 | 4.86 | .0 |
| Summer | 82.1 | 112 | 43 | 6.86 | 5.75 | 10.43 | .0 |
| September | 76.1 | 105 | 34 | 2.88 | 1.42 | 6.51 | .0 |
| October | 64.4 | 98 | 17 | 3.38 | 1.75 | 6.46 | .0 |
| November | 53.1 | 93 | 9 | 1.62 | .03 | 2.73 | .6 |
| Fall | 64.5 | 105 | 9 | 7.88 | 3.20 | 15.70 | .6 |
| Year | 62.9 | 112 | −8 | 26.95 | 14.40 | 40.98 | 5.9 |

## AGRICULTURAL HISTORY AND STATISTICS

Land acquired by the early settlers usually embraced an area of 160 acres to each farmer. It was farmed by the original landowner until certain improvements had been made and payment for the land had been completed. After that, many of the homesteaders leased or sold their farms and established themselves in different lines of trade in the nearby towns. Many of the farms have increased in size through the purchase of additional acreages from adjoining farms, especially in many parts of the eastern half of the county where much of the land is unsuitable for cultivation.

The census of 1930 reports that 94.3 percent of the county is in farms, and that the average size of farms is 188.8 acres. Of the 2,763 farms in the county, 1,080 were operated by owners and part owners, 1,673 by tenants, and 10 by managers. The tenant operators lease the land for a period of 5 years or longer and pay the owner cash or a part of the crops for the use of the land. The customary agreement requires the tenant to give one-third of the crop and pay a cash rent for the use of pasture and hay land.

The improvements on most of the farms consist of a house, a well, and a few small buildings for sheltering the livestock during inclement weather. On account of the mild climate in southern Oklahoma, such large buildings are not required to protect livestock from the weather as in the northern part of the State. The census of 1930 shows that of the total value of all farm property, which is $13,600 on the average-sized farm, 78.1 percent represents the value of land, 10.5 percent the value of buildings, 7.1 percent the value of implements, and 4.3 percent the value of domestic animals. The average acre value of farm land is $53.02.

The implements on most farms include plows, harrows, cultivators, wagons, mowing machines, hayrakes, and numerous small implements used in minor farm operations. A large percentage of the farmers use tractors which in 1930 were becoming more common in some sections of the county, especially in the wheat-growing sections and also where cotton is extensively grown. A few farmers in the wheat-growing sections harvest their grain with combines.

Horses, mules, beef and dairy cattle, swine, chickens, and turkeys comprise the domestic animals on most farms, and a few farmers raise sheep and goats. The principal draft animals are horses and mules, most farmers keeping about three teams for the farm work. The 1930 census reports 5,958 horses, 7,955 mules, 18,561 cattle, 3,231 sheep, 116 goats, and 3,749 swine on April 1 of that year. Jersey and Guernsey are the most popular breeds of cattle, except in that part of the county in which the land is used mostly for pasture, where Hereford cattle are dominant. The raising of swine prevails on a few farms, particularly along the valleys in the eastern part and in the western part, where feed can be produced more easily. The number of chickens raised in 1929 was 331,019, and in the same year 32,937 turkeys were raised.

Expenditures for labor, feed, and farm machinery constitute the important items of expense on the farms. According to the 1930 census, 1,798 farms reported an expenditure for feed in 1929, amounting to $593,245, an average of $330 a farm reporting. The expenditure for labor on 1,990 farms in the same year was $1,537,759, or an average

expenditure of $772.75 a farm. Only 18 farms reported a total expenditure of $3,811 for fertilizer, which included 116 tons of commercial fertilizer. The expenditure of $726,273 was reported on 1,061 farms for implements and machinery, including automobiles, trucks, and tractors. One hundred and forty-one farms reported a total of $7,722 paid to power companies for electric light and power.

The labor on farms is chiefly white, colored labor being extensively employed only during the cotton-picking season. The colored laborers are mostly transients who move from one section to another according to the cotton-picking season. During the last few years colored laborers have been encouraged to remain in the county, and houses have been erected on some farms for their families.

Table 2 gives the acreage and production of the principal crops in Tillman County in stated years as reported by the Federal census.

TABLE 2.—*Acreage and production of the principal crops in Tillman County, Okla., in stated years*

| Crop | 1909 | | 1919 | | 1924 | | 1929 | |
|---|---|---|---|---|---|---|---|---|
| | *Acres* | *Bushels* | *Acres* | *Bushels* | *Acres* | *Bushels* | *Acres* | *Bushels* |
| Corn | 113,391 | 2,365,130 | 31,946 | 867,940 | 14,447 | 307,252 | 8,045 | 144,719 |
| Oats | 17,090 | 381,724 | 17,391 | 667,462 | 19,389 | 573,716 | 7,331 | 129,974 |
| Wheat | 14,749 | 201,794 | 148,315 | 2,586,908 | 67,191 | 1,445,267 | 78,418 | 637,556 |
| Rye | ----- | ----- | 176 | 2,282 | 53 | 780 | ----- | ----- |
| Barley | 20 | 400 | 2,048 | 61,948 | 4,597 | 108,970 | 1,231 | 13,370 |
| Grain sorghums | 2,666 | 29,667 | 4,992 | 99,060 | ----- | ----- | 1,156 | 15,891 |
| Potatoes | 74 | 2,746 | 93 | 8,829 | 48 | 4,453 | 164 | 9,641 |
| Sweetpotatoes | 69 | 4,192 | 47 | 6,538 | 51 | 7,914 | 22 | 2,582 |
| | | *Bales* | | *Bales* | | *Bales* | | *Bales* |
| Cotton | 69,763 | 16,356 | 93,834 | 38,971 | 166,351 | 98,058 | 229,906 | 77,265 |
| | | *Tons* | | *Tons* | | *Tons* | | *Tons* |
| All hay | 7,529 | 7,507 | 4,190 | 6,603 | 4,445 | 7,666 | 5,292 | 11,723 |
| Alfalfa | 4,273 | 5,341 | 3,542 | 5,549 | 3,746 | ----- | 4,105 | 10,649 |
| Prairie grass | 1,979 | 1,388 | 45 | 42 | 71 | ----- | 52 | 50 |
| | *Trees* | *Bushels* | *Trees* | *Bushels* | *Trees* | *Bushels* | *Trees* | *Bushels* |
| Apples | 2,635 | 26 | 3,027 | 1,695 | 2,368 | 1,547 | 1,954 | 2,179 |
| Peaches | 34,541 | 2,713 | 39,088 | 30,506 | 20,379 | 10,055 | 11,426 | 10,145 |
| | | *Pounds* | | *Pounds* | | *Pounds* | | *Pounds* |
| Pecans | ----- | ----- | ----- | ----- | 10,682 | ----- | 7,118 | 27,242 |
| | *Vines* | | *Vines* | | *Vines* | | *Vines* | |
| Grapes | 10,568 | 30,702 | 5,762 | 10,909 | 2,258 | ----- | 4,287 | 24,211 |

Several years after the land was opened for settlement, corn was the predominant crop and cotton ranked second in importance. It has been reported by many who homesteaded land that corn was at first grown very successfully, and during favorable seasons a surplus was produced. After a few years the total corn yield declined, owing both to a decrease in the acreage devoted to the crop and also to a declining acre yield. The census shows that between 1909 and 1929 the corn acreage decreased from 113,391 acres to 8,045 acres, the cotton acreage increased from 69,763 acres to 229,906 acres, and the wheat acreage increased from 14,749 acres to 78,418 acres. More land has been devoted to growing cotton each succeeding year because experience has proved that cotton is more adapted to the climatic and soil conditions, and less risk is involved in growing this crop than corn which is more subject to failure through drought during the growing season, whereas cotton is adapted to a dry condition during certain stages of its growth. A spell of dry weather usually prevails during some part of the growing season.

The average acre yields of corn over a period of years range from 5 to 10 bushels and of cotton from one-half to three-fourths of a bale. The larger yields of both crops are obtained on the sandy soils of the western part of the county. The chief variety of cotton grown is Mebane, although some Half-and-Half, Kasch, Acala, Lone Star, and Rowden are produced. The best varieties of corn, in the order named, are Surcropper, Reid Yellow Dent, and Strawberry Dent.

The average acre yield of wheat ranges between 5 and 12 bushels. Soft wheat is grown principally, Mediterranean being the most popular variety, although some Fulcaster and Stoner are grown. Some hard wheat of the Kanred and Turkey varieties is grown.

Oats rank next to wheat in acreage, and most of the oats produced are used locally for feed. It is reported that oats produce larger yields than wheat in good seasons, the yield ranging from 25 to 35 bushels an acre. The chief varieties are Texas Blackhull and Texas Red.

Grain sorghums, mostly kafir and milo, are grown by most farmers. They rank second to cotton in drought resistance. Blackhull kafir and Dwarf Yellow milo are the varieties commonly grown.

Barley is grown on a small acreage by many farmers. It is a valuable feed for livestock and often takes the place of oats in the rotation.

Sudan grass is grown by many farmers, and the acreage is being increased rapidly. It is especially valuable for summer grazing, or it may be cut for hay.

Alfalfa is grown most successfully on the sandy soils over the western half of the county and also on land along the valleys in the eastern half. In such localities a few acres are devoted to alfalfa on most farms. A few farmers in western Tillman County have been growing alfalfa successfully on a commercial scale, and the hay produced is of excellent quality. Alfalfa does not make a good stand on the heavy upland soils in the eastern part of the county. If abundant moisture is available in the spring, a good crop of hay is produced from the first cutting, but the succeeding cuttings, because of lack of soil moisture, are very poor.

A few farms on the sandy soils include a small orchard, mainly of peach trees, with some plums, pears, and grapes, and a few commercial peach orchards are in the southern part of the county. Fruit is often damaged by late frosts, and in some years the crop is a complete failure. Apple trees are not very successfully grown, and only a few small apple orchards are in the county.

Most farmers have a small garden, usually maintaned by irrigation from a well. The principal vegetables grown are spinach, turnips, sweet peppers, green onions, okra, cabbage, tomatoes, mustard for greens, beans, sweetpotatoes, potatoes, and peas. Watermelons do well on the sandy soils and are grown by some farmers for local markets. Tom Watson, Halbert Honey, and Kleckley Sweets are the leading varieties. Cantaloups are grown for local use, the Rocky Ford variety being the most successfully grown.

Wild pecan trees are abundant and thrifty on some of the alluvial soils.

## SOILS AND CROPS

The soils of Tillman County may be divided on the basis of surface soil characteristics into two groups—one in which they have a sandy surface soil, referred to as the sandy soil group, and the other in which

they have finer grained surface soil material, designated as the clay loam group. These soil groups are each continuously developed over an extensive area so that the land in the county is composed of soils belonging to two widely different textured groups. The clay loam group covers the northeastern half which for convenience will be referred to as the eastern belt. The sandy soil group occupies the rest of the county and forms the area designated in this report as the western belt.

In both the eastern and the western soil belts about 72.5 percent of the land is devoted to crops, and the rest is used for pasture.

In the following pages of this report the soils of Tillman County are described in detail, and their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 3.

TABLE 3.—*Acreage and proportionate extent of soils mapped in Tillman County, Okla.*

| Type of soil | Acres | Percent | Type of soil | Acres | Percent |
|---|---|---|---|---|---|
| Enterprise very fine sandy loam | 39,744 | 6.9 | Randall clay | 4,480 | 0.8 |
| Enterprise loamy very fine sand | 60,352 | 10.5 | Miller clay | 6,400 | 1.1 |
| Enterprise loamy fine sand | 11,520 | 2.0 | Miller clay loam | 27,008 | 4.7 |
| Enterprise loamy fine sand, flat phase | 14,656 | 2.5 | Portland silty clay loam | 8,768 | 1.5 |
| Enterprise fine sand, deep phase | 9,728 | 1.7 | Vernon clay loam | 43,520 | 7.6 |
| Tillman very fine sandy loam | 26,560 | 4.6 | Vernon clay loam, eroded phase | 23,744 | 4.1 |
| Tipton very fine sandy loam | 29,760 | 5.2 | Vernon very fine sandy loam | 9,856 | 1.7 |
| Yahola silty clay loam | 1,728 | .3 | Dune sand | 25,920 | 4.5 |
| Miller very fine sandy loam | 4,288 | .7 | Yahola very fine sandy loam | 12,288 | 2.1 |
| Foard silt loam | 52,032 | 9.0 | Yahola fine sand | 6,784 | 1.2 |
| Foard clay | 16,896 | 2.9 | River wash | 18,304 | 3.2 |
| Kiowa clay | 14,976 | 2.6 | Rough stony land | 256 | .1 |
| Calumet very fine sandy loam | 38,336 | 6.7 | Total | 576,000 | |
| Tillman silt loam | 68,096 | 11.8 | | | |

## SOILS USED MOSTLY FOR GROWING CROPS

In the eastern belt, land that is used for crops includes soils that range from very dark grayish brown to chocolate brown. The surface soils consist of friable material to a depth of 4 or 6 inches. Below this depth, where developed on the uplands, the soil material grades into a brown subsoil of heavy compact material which continues downward to a depth of 36 inches, where it merges with reddish-brown material. In the valleys the surface soils grade into reddish-brown subsoils which in most places are similar in structure to the surface material. Lime in concretionary form is generally present in the upland soils at a depth of 20 inches, and it is also in the surface soils and subsoils in sufficient amounts to maintain a neutral reaction with Soiltex. In the valley soils in many places calcium carbonate occurs within 4 inches of the surface in sufficient quantities to produce effervescence with acid. The surface soils are darker on the flat or gently rolling upland areas and on valley bottoms where considerable material has been contributed from areas of dark-colored upland soils. On slopes, the dark-colored surface layer is thin, or, in places, lacking, causing the reddish-colored material almost universally underlying the dark-colored surface soil to lie on the surface. In places where material from these slopes has been washed into small valleys, the alluvial soils are red also. Taken as a whole, the soils of the

county can very readily be brought by cultivation into a state of good tilth. In the heavier soils a granular structure is very noticeable in fields where the surface material is drying after a rainfall. This condition usually loosens the surface material to a depth of 2 or 3 inches so that a good impression of footprints can be made in walking over the ground. In places the surface material is gray and, wherever this color is decidedly developed, the surface material is like very fine sandy loam. On drying such soils become covered with a hard crust, and on plowing it breaks up into very cloddy material requiring considerable working before good tilth can be obtained. The subsoils in such areas are in general very dense and compact.

The crop-producing soils of the western belt, like those of the eastern belt, occur in both uplands and valleys, but, regardless of their position, they are in many places similar in general characteristics in both surface soil and subsoil. These soils are brown or chocolate brown to a depth ranging from 6 to 12 inches, where they grade into reddish-brown friable sandy subsoils which extend downward with very little change in structure or color to a depth of 36 or more inches. The surface soils are darker in the flat areas and somewhat more red in color and coarser in texture in the more rolling areas. None of the material contains sufficient carbonate to produce a calcareous reaction with acid, although tests with Soiltex show a slightly alkaline reaction, indicating sufficient lime to be beneficial to growing crops.

These soils of the western belt differ from those of the eastern belt in that they consist of much more friable material in both the surface soils and subsoils. Furthermore, instead of a friable surface soil passing into a heavy plastic clay subsoil, as occurs in the soils of the eastern belt, the friable condition of the surface material of the soils of the western belt continues for considerable depth below the subsoil where the material is equally as friable. This friable characteristic of the soils in the western belt provides the most favorable conditions for growing crops. It allows the absorption of large amounts of rainfall and the storage of large quantities for future crop use. It also allows normal plant-root development and facilitates good soil drainage. With the absorption of moisture a large amount percolates to a great depth because of the porous character of the material, and when all the material to a great depth is saturated with moisture a large amount is stored for crop use, and the growing crop is provided with available moisture for a much longer period in the growing season than would occur in soils in which the absorption was slight. Then, if a period of very little rainfall occurs for some time, enough moisture may be available to carry the crop through the critical stages of its growth and insure a normal crop yield.

In the soils of the eastern belt, rainfall is not readily absorbed in large quantities because of the semi-impervious character of the subsoils, and therefore, the supply of available moisture is often limited for growing crops and is exhausted before the end of the growing season. As a consequence, crops suffer and their growth is retarded until the next rain. During the spring of 1930, it was noted that, after a heavy rainfall, moisture had penetrated the ground in the western belt to a depth of more than 24 inches and in the eastern belt to a depth of only 10 or 12 inches.

Where the friable subsoils are developed the natural grassland vegetation has a deep root system and a tall growth because of the

large amount of moisture available to the plants. But in the eastern belt, where the compact impervious subsoil is developed, short grasses are dominant and the root systems are more shallow. Therefore, crops that are shallow rooted and do most of their growing when plenty of moisture is supplied in the surface soil by rainfall are usually successfully grown on soils with heavy subsoils; and crops that are deeply rooted and do most of their growing when moisture is not readily supplied in the surface soil by rainfall, are more successfully grown on soils with friable subsoils.

The good drainage in the soils of the western belt allows all the moisture falling on the surface to percolate to a great depth, where it can be stored without any harmful effects on the growth of the crop; but in the eastern belt, the impervious character of the subsoils causes an excessive accumulation of moisture in the surface soils, especially during wet seasons, and water remains wherever the surface is very level. Therefore, as a result, considerable difference in crop growth occurs in the soils of the two belts. In the western belt a normal crop is developed, as the good subsoil drainage promotes a condition that is most favorable for growing plants; but in the eastern belt, where poor drainage exists during wet seasons, crops are stunted in their growth and are not normally developed.

The existence of these favorable crop-growing conditions in the western belt is evidenced in several ways: (1) Many of the leading crops are more extensively grown in this belt than in the eastern belt; (2) a few of the leading crops are grown only in the western belt; and (3) all crops are more successfully grown in the western than in the eastern belt.

The leading crops, as a whole, may be listed according to their acreage as follows: Cotton, wheat, corn, oats, alfalfa, barley, grain sorghums, and rye; but when either the western or eastern belt is separately considered, an entirely different arrangement in the list of these crops according to acreage must be made. Cotton, which ranks first in acreage and importance for the county as a whole, is also first in the western belt; and in some years ranks first in some parts of the eastern belt, although wheat nearly always ranks first in acreage in this belt, with cotton second. Wheat, with oats and barley, ranks last in the list of crops grown in the western belt. Corn is of much greater importance in the western belt, compared with the county as a whole and may be placed second in importance among the crops grown in the western belt. In the eastern belt the corn acreage is very small, being confined mostly to the valley land, and therefore it ranks last in the list of crops grown in this belt. Alfalfa and rye, which are near the end of the list of crops, according to acreage, are grown almost entirely in the western belt. Their production as feed for livestock in the western belt is invaluable. Kafir is as important in one belt as in another, and, therefore, the total acreage devoted to this crop is about equally distributed over the county. It is grown primarily to supply feed for livestock on the farms. This crop is said to be more successfully grown in the western belt.

Each of the leading crops—cotton, wheat, oats, corn, barley, alfalfa, and rye—are grown more extensively in one belt than in the other because they can be more profitably produced in that belt. Cotton is the most profitable crop in most sections of the county, and it is

better adapted to the prevailing climatic conditions than many other crops. It usually comes through a droughty period in summer in much better condition than most other crops, many of which are injured to the point where yields are reduced considerably. Therefore, cotton becomes naturally the dominant crop in the western belt where the soils are most favorable for crop production. On account of its adaptability to this section, it is often a strong competitor with other crops in areas having less favorable soil conditions, especially during years when market prices of cotton are high enough to bring profitable returns. In such years a greater acreage is devoted to cotton in the eastern belt than is customary, but the crop is not so profitably produced in this belt as in the western belt because soil conditions make it less productive.

Wheat could also be more profitably grown on the heavier soils in the western belt than on the soils of the eastern belt, but, as cotton is the most profitable crop, wheat is practically excluded from the western belt. It is grown chiefly in parts of the eastern belt where cotton is less profitably grown. Although cotton may be grown in the eastern belt, the use of modern machinery over large areas reduces the cost of production of wheat to such an extent that it is here more profitable than cotton, not because soil conditions are more favorable to the wheat plant, but because wheat can be more economically produced. Another reason that wheat is the more profitable crop in the eastern belt is that it can be more easily taken care of than cotton, especially on the heavy soils. On account of the heavy character of the surface soils, considerable difficulty is experienced in preparing a seed bed for cotton during the spring. At this season there is usually considerable rainfall, and the soils remain wet for some time and delay seeding operations so that a cotton crop may not mature properly before the end of the season. However, in growing winter wheat, the land need not be disturbed during the spring, when this crop makes most of its growth. Also, at this time plenty of moisture is available in the surface soils, and very little root penetration into the subsoil is necessary to obtain sufficient moisture for the growth and maturity of the crop. Therefore, unlike other crops that make most of their growth during the summer, wheat is not affected so much by the heavy plastic claypan subsoils.

Alfalfa requires a large amount of moisture for its continuous growth during the season, and it is, therefore, grown mostly in the western belt, as soil conditions in this belt favor the accumulation of large amounts of moisture. Alfalfa has roots that penetrate the soil to a great depth in order to obtain a large amount of moisture. If this root system is curtailed in its development and its growth restricted mostly to the surface soil, very little moisture is available for the growing crop. In the soils with claypan subsoils, alfalfa roots do not develop so extensively as in the more friable soils because the hard material is not so easily penetrated by the growing roots; and, furthermore, because the hard material of the subsoil has prevented very little moisture to accumulate below, alfalfa roots will not develop there. Observations made during the dry spring of 1930 showed the alfalfa crop to be much shorter on the soils of the eastern belt than on those of the western belt where the soils have friable subsoils. When alfalfa in the eastern belt was about 2 or 3 inches high, in the western belt it was 10 or 12 inches.

Corn is another crop that requires much moisture for its successful growth, and its most critical period of growth is in midsummer after the season of abundant spring rain. It is often more successfully grown on soils of lower fertility than on more fertile soils because it happens that some available moisture is in the less fertile soil during the tasseling stage. This occurs only when the more fertile soils are depleted of available moisture in an earlier part of the season than are the less fertile soils. Because the soils in the western belt, where corn is largely grown, are capable of storing large amounts of moisture, and sufficient moisture is available during the driest part of the season, the crop does not suffer as it would if it were grown on the soils of the eastern belt, where a smaller amount of moisture is stored for future use.

Most of the rye is grown in the western belt for use as pasture during the winter. It has proved to be much better adapted than wheat to the sandy soils of the western belt.

The acreage devoted to oats, barley, and grain sorghums is not influenced by soil conditions, as compared with the major crops, in that it is practically the same in both soil belts. However, these crops are more successfully grown in the western than in the eastern belt. The reason that their acreage is equally distributed over the two parts of the county is that every farm requires some forage feed for livestock.

The soils used for crop production are represented by several soil types, each described in subsequent pages of this report.

### SOILS OF THE WESTERN BELT

**Enterprise very fine sandy loam.**—The topsoil of Enterprise very fine sandy loam consists of brown or chocolate-brown loamy fine sand or light sandy loam that passes into brown light sandy loam at a depth of 10 inches. This layer, in turn, continues downward to a depth of 18 inches, where it merges into reddish-brown sandy clay material, below which the material changes very little in character to a depth ranging from 5 to 8 feet. This soil includes the areas of darkest colored soil in the western belt. It is the most highly prized soil in this section, as it is both productive and resistant to drought. The surface soil is easily worked into a good tilth, and cultivation is readily accomplished.

**Enterprise loamy very fine sand.**—The 6-inch surface soil of Enterprise loamy very fine sand is dark-brown or grayish-brown sand. It grades into a reddish-brown subsoil, and this layer, in turn, continues downward to a depth of 14 inches, where it passes into reddish-brown material slightly heavier in texture than the material in either the surface soil or subsoil. This material continues downward to a depth of 60 or more inches with very little change in color or texture. The areas of this soil are characterized by a rolling or hummocky relief.

**Enterprise loamy fine sand.**—The surface soil of Enterprise loamy fine sand is grayish-brown friable incoherent sand to a depth of 6 inches. Below this depth is reddish-brown friable material of similar structure and texture, extending to a depth of 36 or more inches. Below this depth and continuing to a depth of more than 60 inches, the material may consist either of loose sand or it may contain a small percentage of clay.

Enterprise loamy fine sand covers a large total area. It occurs in a narrow, almost unbroken north-south band across the western belt. The surface relief is gently undulating or flat, and drainage is good.

Enterprise loamy fine sand differs from Enterprise loamy very fine sand in that the layer of very sandy material extends to considerable depth, and the soil occupies flat areas, as compared with the rolling areas of Enterprise loamy very fine sand. The surface relief in some bodies is marked by low mounds, with coarser sand in places, and therefore, the soil is easily moved by wind.

**Enterprise loamy fine sand, flat phase.**—Enterprise loamy fine sand, flat phase, differs from typical Enterprise loamy fine sand in that the sand extends to a depth of 18 or 20 inches. It is underlain by the heavier material, which occurs in the subsoil of Enterprise loamy fine sand at a slight depth. This material continues downward for several feet with very little change in character. This soil has a smooth surface relief.

**Enterprise fine sand, deep phase.**—Enterprise fine sand, deep phase, has a gray sand surface soil 6 inches thick, and underneath this is a reddish-brown sand subsoil. The material in both surface soil and subsoil is loose and incoherent, and it contains more coarse sand than any other soil of the Enterprise series. The surface soil is shifted about more readily by the wind than are the surface soils of the other types of the Enterprise series. The subsoil continues downward to considerable depth with no change in color or texture.

Because the surface soil drifts easily during high winds, extreme care must be taken when the land is put under cultivation. Drifting of the surface soil is most noticeable during the spring when very little vegetation is on the surface.

The soil differs from Enterprise loamy fine sand, flat phase, in that the surface soil material contains a larger quantity of coarse sand and medium sand and in that it drifts more easily.

**Tillman very fine sandy loam.**—The 6-inch surface soil of Tillman very fine sandy loam is brown or reddish-brown very fine sandy loam. It is underlain by a reddish-brown subsoil of friable silt loam or very fine sandy loam. Continuing downward the subsoil grades, at a depth of about 15 inches, into reddish-brown or light reddish-brown clay which is plastic when wet and very hard when dry. Lime is present at a depth of 18 or 20 inches.

Tillman very fine sandy loam borders the areas of clay loam soils adjoining the sandy soil areas. This is a very productive soil, and cotton is the principal crop grown.

**Tipton very fine sandy loam.**—Tipton very fine sandy loam has a very dark grayish-brown surface soil grading at a depth of 8 inches into a brown subsoil which continues downward to a depth of 18 inches, where it passes into brown calcareous material containing a large quantity of lime. The surface soil material is friable very fine sandy loam, and good tilth is easily obtained under cultivation. The subsoil is also friable but may contain slightly more clay than the surface soil material. The texture ranges from very fine sandy loam to silt loam.

This soil is very similar to Enterprise very fine sandy loam in color and structure of the surface soil, but it differs from that soil in that the lime in the subsoil is nearer the surface.

Tipton very fine sandy loam occurs in flat terracelike areas. Drainage in general is good, although in spots it is poor. This is considered the most productive soil for alfalfa.

**Yahola silty clay loam.**—The surface soil of Yahola silty clay loam is dark-brown or brown silty clay loam that passes downward, at a depth of 12 inches, into yellow or reddish-yellow very fine sand. This material, in turn, continues downward to a depth of 36 inches and grades into gray sand. The material in both the surface soil and subsoil is calcareous.

The total acreage of this soil is very small, only 2.7 square miles being mapped.

**Miller very fine sandy loam.**—Miller very fine sandy loam has a brown or reddish-brown friable very fine sandy loam surface soil extending to a depth of 12 inches, where it passes into a reddish-brown friable silt loam subsoil which extends downward to a depth of 60 or more inches. In places the surface soil is very dark colored, and the soil in such areas could, perhaps, be included in the Portland series, but owing to the small size of these areas of dark-colored soil and the friable characteristics of the subsoil, the bodies are included with Miller very fine sandy loam in mapping.

### SOILS OF THE EASTERN BELT

**Foard silt loam.**—The surface soil of Foard silt loam consists of brown or dark-brown friable loam or silt loam, which merges, at a depth of 6 or 7 inches, into a dark-brown or brown subsoil of tough plastic clay or silty clay. This continues downward, and the color gradually changes with increased depth to reddish brown or lighter brown. At a depth of 18 inches, lime, in the form of concretions, occurs.

When very dry this soil has a gray cast on the surface. In many places it is spotted with small patches of reddish-brown material that may have been brought to the surface by prairie dogs. In these patches, the surface soil is calcareous, and concretions of lime are in evidence.

Good tilth is easily developed in this soil. As observed in fields seeded to wheat, the surface soil develops a granular structure which is conducive to conserving soil moisture. In most places the surface soil extends below the ordinary plow depth, so that very little difficulty in cultivation is experienced. If the plow cut into the heavy clay subsoil, more power would be needed to do the work, and the preparation of a seed bed would be more difficult, as the clay subsoil that would be brought to the surface would form a cloddy structure that would be hard to reduce to a pulverulent condition.

The most extensive areas of Foard silt loam are southeast of Frederick. This soil occurs in areas on which the surface relief is almost flat, though many bodies have a very gentle slope toward the small drainageways.

**Foard clay.**—The surface soil of Foard clay consists of very dark brown or brown clay that grades at a depth of 4 or 5 inches into dark-brown clay which is sticky when wet, plastic when moist, and very hard when dry. When wet the surface soil appears nearly black but on drying assumes a dark-gray shade. The surface material has a very granular structure when drying, small angular soil particles

being formed beneath the surface crust, and the surface crust breaks up into small fragments which are easily reduced.

This soil is developed in flat areas, and drainage is poor. During seasons of frequent rains a favorable soil condition seldom prevails for cultivation, as the soil never becomes dry enough before the next rain occurs. On account of this condition, some difficulty is experienced in preparing the land for crops during early spring.

The most extensive areas of Foard clay are in the vicinities of Loveland, Tillman, and Pleasant Valley School.

Foard clay is very productive during normal seasons. It is especially suited to growing wheat, and the largest wheat acreage of the eastern belt occurs on this soil. Wheat usually produces a few more bushels an acre on Foard clay than on any other soil in the eastern belt.

On account of the shallow surface soil, this soil is much more difficult to cultivate than Foard silt loam. The plow depth in many places extends into the heavy tough clay subsoil, requiring more power to pull the plow.

This soil differs from Foard silt loam in that the surface soil contains more clay and is slightly darker.

**Kiowa clay.**—Kiowa clay has a very dark grayish-brown clay loam surface soil that is very granular in structure. It is underlain at a depth of 6 or 8 inches by a brown or dark-brown clay subsoil which is sticky and plastic when wet. The surface soil is variable and contains numerous patches of reddish-yellow material. In places these colored patches are so linked together as to form strips separated by bands of dark-colored soil. Lime, in the form of concretions, is distributed over the surface of these reddish-yellow patches. Kiowa clay is prominently developed in the northeastern part of the county.

This soil differs from the Foard soils in that the surface material is more granular, and the subsoil is slightly less plastic and sticky when wet. Also, on account of the granular or mellow structure of the surface soil, the soil may have a higher content of organic matter and nitrogen.

Wheat is the predominant crop on this soil.

**Calumet very fine sandy loam.**—The surface soil of Calumet very fine sandy loam is brown or chocolate-brown very fine sandy loam. Below a depth of 6 or 8 inches it rests abruptly on a subsoil of tough heavy clay ranging in color from very dark chocolate brown to chocolate brown and in places to reddish brown. At a depth of about 18 inches the subsoil is commonly calcareous and contains lime concretions. In a freshly tilled dry field small spots of dark grayish-brown soil occur in slight depressions where water stands longer than elsewhere. These spots have very dark brown topsoils, and the subsoils are almost black when wet. In some small slightly undulating areas the subsoil has a decidedly red shade.

A hard crust forms on the surface during hot dry weather, and the subsoil becomes very hard and tough and breaks into small hard clods only by exertion of considerable force.

This soil differs from the Foard soils in that it has a more gray surface soil and a more compact subsoil. On account of its gray surface color, this soil is commonly called "white land."

Calumet very fine sandy loam is developed on high flat stream terraces, or bench land. Drainage is poor because of the flat surface. On account of its position with respect to the general surface level, the

surplus moisture from surrounding areas of higher elevation flows onto it and deposits fine material, including alkali salts. During wet seasons, the surface soil often becomes so saturated with moisture that it is soft or boggy.

During dry seasons, crops on this soil are much more badly injured than crops on any other soil in the eastern belt.

**Tillman silt loam.**—Tillman silt loam has a chocolate-brown friable silt loam surface soil that merges, at a depth of 6 inches, into a dark-brown clay loam subsoil continuing downward to a depth of 12 inches, where it is underlain by chocolate-brown or reddish-brown tough plastic clay which becomes very hard when dry. The material is calcareous at a depth of 24 inches.

Tillman silt loam differs from Foard silt loam in that the surface soil is thicker, has a more red or brown color, and the subsoil is much less heavy and plastic. On account of these conditions, farmers report that this soil is much easier to till than any other soil in the eastern belt.

Crops can be grown as successfully on this soil during normal seasons as on the most favorable soils in the eastern belt; however, crop yields are, perhaps, not so large as those obtained on Foard silt loam.

Tillman silt loam is developed on smooth gently rolling areas, and drainage is good. On account of the gentle slope of the land occupied by this soil, sheet erosion in many places is very destructive and the surface soil is being washed away.

**Randall clay.**—Randall clay consists of material that is very uniform in color and structure from the surface to a depth of 30 inches. The material is calcareous, is dark gray or gray, and is very plastic and sticky when wet. When dry the immediate surface material, which is clay or silty clay, has a decidedly gray shade, and it breaks up into small granular pieces.

This soil occurs in low depressions formerly occupied by lakes which have been artificially drained. It occurs principally in one large area, southeast of Frederick, known as Hackberry Flat. Two very small bodies are north of Davidson. Wheat is the principal crop grown on this soil.

**Miller clay.**—The surface soil of Miller clay when wet consists of tough plastic reddish-brown clay which grades, at a depth of 12 inches, into a chocolate-brown clay subsoil. This continues downward to a great depth without any change in color or structure. Both surface soil and subsoil material effervesce with acid. The surface soil breaks into a granular structure when drying, and the subsoil material becomes very hard and intractable.

Miller clay occurs on high bottom land. During heavy rainfalls it is subject to overflow, but at other times drainage is good.

Wheat and cotton are the principal crops grown. On account of the heavy surface soil, considerable difficulty is experienced in cultivation. Plenty of power is needed to pull the plows, and great care must be taken in order to plow such land at the proper time to develop a good tilth.

**Miller clay loam.**—The surface soil of Miller clay loam consists of reddish-brown friable clay loam that grades, at a depth of 6 inches, into a brownish-red clay subsoil. This continues downward to a depth of 18 inches, where the soil material is yellowish-red clay. Both

the surface soil and subsoil material are friable and granular when dry. Nearly all the soil material in the profile, except the 6-inch surface soil, effervesces with acid.

Miller clay loam differs from Miller clay only in that the surface soil is more friable and does not contain so much clay as Miller clay. Because Miller clay loam has a more friable surface soil, it is preferable to Miller clay for cultivation.

**Portland silty clay loam.**—The surface soil of Portland silty clay loam is dark-brown or brown clay loam which passes into a chocolate-brown clay subsoil at a depth of 6 inches, and this layer continues downward to a depth of 15 inches where it passes into reddish-brown clay. Both the surface soil and subsoil material are friable and granular, but none of the material effervesces with acid.

Portland silty clay loam differs from the Miller soils in that it has a darker colored surface soil, and none of the material in either the surface soil or subsoil effervesces with acid.

This soil occurs along low stream bottoms, and drainage is good. Wheat and cotton are the principal crops produced.

## SOILS USED MOSTLY FOR PASTURE OR NOT CULTIVATED

Most of the land used for pasture is about equally divided between the eastern and western belts. The different soils composing such land are unprofitable producers of crops. In the western belt these soils are, as a rule, so loose and porous, consisting mostly of loose incoherent sand, that very little available moisture is retained in them, and a very large proportion of the surface material is constantly being shifted about by the wind. As a consequence, crops either do not mature properly because the low moisture supply promotes very little growth or they are destroyed by the shifting surface material. Many of these soils in the western belt include areas whose surface is rough or moundy, or they occupy river bottoms and are subjected to frequent overflows.

The uncultivated lands of the eastern belt are subject to severe surface erosion, as they occupy steeply rolling areas where surface run-off is very rapid. This naturally results in the exposure of the subsoil and the formation of gullies. Land in such a condition is cultivated with great difficulty. Crops do not produce enough to pay for the labor used in cultivation, because the soils, during a rainy period, on account of their dense plastic character, do not absorb enough moisture for crops to grow properly, and shortly after a rainy period they dry out so quickly that crops suffer severely.

The uncultivated lands, like those under cultivation, include several soil types. It must be remembered, however, that some small areas may be in cultivation, but that the greater part of their total acreage is not cultivated.

### SOILS OF THE EASTERN BELT

**Vernon clay loam.**—In general, Vernon clay loam consists of red clay to a depth of more than 3 feet. The topmost part of the material is waxy or plastic clay when wet, and very hard when dry. In places shale is present in the surface soil and subsoil. This soil varies from place to place in color and character of material. In many places erosion has exposed the deep layers of parent material, and the immediate surface soil consists of unweathered parent material.

The areas of Vernon clay loam are rolling, many of the slopes being steep and somewhat eroded and gullied. Drainage is excessive.

The vegetal cover consists of native grasses and a few small scattered mesquite trees. The native grasses are mainly buffalo grass, needlegrass, and a number of weeds, of which broomweed is the most abundant.

**Vernon clay loam, eroded phase.**—The term eroded phase is used to indicate areas of Vernon clay loam that have been so badly eroded that no surface soil remains. In most places the surface soil material appears to consist entirely of freshly exposed "Red Beds" material without accumulation of true soil. In most places fragments of rock are strewn over the surface. This eroded land has very little agricultural value even for grazing, owing to the sparse covering of grass. The slopes are rough and broken.

**Vernon very fine sandy loam.**—The 8- to 10-inch surface soil of Vernon very fine sandy loam consists of brownish-red or reddish-brown very fine sandy loam that grades into a dark brownish-red clay subsoil similar in character to the subsoil of Vernon clay loam. The subsoil is sticky and very plastic when moist and in most places at a depth of 15 inches effervesces with acid and contains lime in the form of concretions. The material is very uniform in color and structure to a depth of 36 or more inches.

This soil is developed on slopes or narrow ridges where the disintegrated "Red Beds" material contains sandstone fragments on the surface. This soil is most extensive in the vicinity of Grandfield along the south bluffs of Deep Red Creek Valley, and north of Frederick.

As the surface soil erodes easily, the land is not suitable for cultivation.

### SOILS OF THE WESTERN BELT

**Dune sand.**—The surface layer of dune sand consists of gray loose fine sand which is light brown when moist. The gray material continues to a depth ranging from 4 to 8 inches, and below this it gradually changes to a reddish yellow or reddish brown. In some places this underlying material is distinctly yellow, but, whatever the color of the material below the surface soil, it consists of loose incoherent sand that continues downward to a great depth. The material in most places is calcareous. On account of the uneven surface relief, considerable variation occurs in the surface soil, especially in very small depressions where a somewhat stabilized condition has allowed the accumulation of organic material as well as fine sand and silt. In such places the soil differs from that in other parts of the dune sand areas in that the surface soil is darker and consists of finer soil material ranging from fine sandy loam to silty clay loam.

The areas mapped as dune sand form a broken band that parallels the river beds of Red River and North Fork Red River along the southern and western sides of the county. In places it extends from the edge of the river channel over the valley to a short distance beyond the edge of the upland, and in other places it occupies only narrow belts on the upland adjacent to the river valley. Dune sand supports a scant covering of vegetation composed of bunch grass, plum bushes, and Yucca, but this vegetation is not sufficiently dense to prevent the incoherent surface sand from drifting during

high winds. In places the material is piled into dunes that range from 10 to 15 feet in height. Most of the dunes occur in the narrow belt paralleling the river bed and are separated by narrow strips of lowland.

**Yahola very fine sandy loam.**—The surface soil of Yahola very fine sandy loam is grayish-brown loamy very fine sand extending to a depth of 6 inches, where it grades into lighter colored incoherent sand that continues downward to considerable depth. The water table is about 15 inches below the surface, and below that depth the material is completely saturated with water. All the soil material effervesces with acid.

This soil is not extensive. It occurs mainly along the bottoms of Red River, North Fork Red River, and Otter Creek. It is subject to overflow during periods of high rainfall. Because the land is frequently inundated, the surface soil is variable in character. Some areas contain more coarse material in the surface layer than others, and in some places the surface relief is rough, whereas in others it is comparatively smooth. In the rough areas the surface soil is very coarse in texture and tends to drift.

A large part of this soil is covered with a sparse growth of willows and cottonwoods.

**Yahola fine sand.**—With the exception of the land mapped as river wash, Yahola fine sand represents the most recently formed accretionary land, consisting of areas in which constant disturbance by overflow from the river has ceased most recently. The river has shifted to another part of the valley bottom so that the overflow from its channel occurs less frequently, or not at all, over that part of the valley where Yahola fine sand predominates. In general this soil occurs in the bends of the river valley, where it is evident that the river water formerly swept against the bluffs and since has shifted to other parts of the valley.

Yahola fine sand consists of yellow and gray coarse sand to a depth of 36 or more inches, with no change in character. In places it consists of much coarser material than elsewhere. Such areas are devoid of vegetation, and the material drifts easily during hard winds. The surface relief is rough and hummocky. Willows, cottonwoods, and broom grass constitute a sparse vegetation over the land.

**River wash.**—River wash includes the areas of river-bed material occurring along Red River and North Fork Red River. It consists of deep beds of water-transported sand, ranging in texture from very fine to coarse and in color from grayish red, or light flesh color, to a very light chocolate color and even chocolate red in some of the layers or pockets of finer textured material. Small water-worn gravel of quartz and other rocks are scattered over the surface and are present, in places, throughout the mass beneath.

The surface of river wash is from 1 to 5 feet above the bottom of the river channel, and the land is flat, with a gradual downstream grade. The surface is slightly altered by wind and the receding water ripples, and when the material is dry drifts of sand are constantly moving over the surface. Some of the finer particles are blown onto adjacent higher bottoms, and the coarser materials are left on the river bed.

River-wash material is never dry to a great depth, as water lies within 12 inches of the surface even during the dry season.

**Rough stony land.**—Land mapped as rough stony land occurs in very small areas in the northwestern part of the county. It represents

an outlier of the Wichita Mountains in southwestern Oklahoma. It consists chiefly of a mass of granitic boulders and is devoid of any soil accumulation on the surface or any vegetal growth.

## AGRICULTURAL INDUSTRIES

Agricultural industries, defined as a series of activities concerned with the conversion of agricultural products from the form of crops into finished or partly finished products, are of very little importance.

The cotton crop is baled, the numerous cotton gins located in practically every town constituting probably the most important crop-processing industry, the units, as everywhere, being small and individually employing less than half a dozen men. The processing of cottonseed is now done on a larger factory scale than is the ginning. A cottonseed-oil mill at Frederick employs a number of men in the manufacture of cottonseed oil and cake.

The wheat crop, the crop next most important to cotton, is not processed in the county. There are no large flour mills, but a few very small local mills convert corn and a small amount of wheat into corn meal and feed.

By considering the native grass and pastures a crop, the raising of livestock on pastures, with incidental feeding in winter, may be considered a kind of crop processing and the production of a finished product.

The livestock industry in the eastern belt is maintained mainly on the feed obtained from the pastures of native grasses or from recently seeded wheat fields, as feed from this source is the most economical in this part of the county. Sufficient feed from forage crops grown in this belt cannot always be assured, because soil conditions during abnormal seasons result in a shortage in yield, and the yield is never large enough to be profitable. However, the soils in this belt are capable of growing grass and grain crops that can be used for pasture, and practically all the untillable land in the eastern belt provides good pasture. Land planted to wheat is used for pasture during the fall and winter, as the wheat at this time furnishes an abundance of green feed. Many farmers report that it is a very desirable practice to pasture wheat fields during the fall and winter in order to prevent too much growth before winter freezes commence; otherwise, the wheat crop is apt to be destroyed. It is customary among farmers who plant a large acreage to wheat to lease their wheat land for pasturing livestock at a nominal fee a head. Therefore, the livestock industry is developed extensively on some farms in the eastern belt merely for the purpose of utilizing the feed that is available on uncultivated land and wheatland.

Most of the cattle are sold directly from pasture, and on a few farms, especially in the valleys, cattle are sometimes fed and later sold on the market as fat cattle.

The livestock industry in the western belt is developed on a different basis from that in the eastern belt. Instead of feed for livestock being available from grasses on uncultivated land and from wheat fields, as in the eastern belt, most of the feed is provided by growing forage crops. This can be easily accomplished on the soils of the western belt because soil conditions make it possible to grow an abundance of

forage successfully every year. The forage crops provide the only source from which most of the feed in the western belt can be obtained, as the areas of uncultivated land produce very little feed or are practically unsuitable for grazing; but the growing of forage crops is limited on most farms because of the preference of the farmers to grow cash crops, such as cotton or wheat. Forage crops are grown on a few farms, however, where the farmer is interested in raising livestock, where he desires to maintain the productivity of his land, where he can easily dispose of the livestock products on the local market, or where he can provide sufficient feed for his livestock.

The farmer who is interested in raising livestock usually maintains a good herd of cattle which may be headed with a good grade or a registered sire. The cattle may be of the beef type, or they may be of the dairy type if the farm is near a large city or a good local market where a ready sale for dairy products exists. A few sheep and swine are kept on some farms in the western belt.

Maintaining the productivity of the soil on the farm can be accomplished by restoring to it elements that have been lost in the production of crops; and this is only possible on farms where crop rotation is practiced and some form of organic matter is added to the soil. The growing of forage crops to furnish feed for livestock provides an opportunity for the farmer to rearrange his fields so that part of the land will produce a different crop each year, and the organic matter made available in the form of manure from the livestock fed on the farm can be returned to the land. Changing crops each year seems to maintain the productivity of the land, as the crops are produced more abundantly as compared with crops produced on the same kind of land where no crop changes have been made for several years. The same applies to land that receives an application of manure, compared with land that has never received any manure.

The products of the livestock industry sold on the local market include milk, cream, butter, meat, and eggs. If the demand for these products is large and if the distance to market is sufficiently short that the farmer can quickly transport these products, some branch of the livestock industry is developed.

Plenty of feed for the livestock is an important factor to consider in the development of a livestock industry. This is easily accomplished in the western belt, as the soils are good producers of forage crops, especially alfalfa, which is a highly prized feed. This crop is reported to produce excellent yields of hay from 4 or 5 cuttings a season. On some farms the crop is grown for the local market, and excellent returns have been reported. Kafir, millet, and other varieties of hay and forage are successfully grown for feed in the western belt

## AGRICULTURAL METHODS AND SOIL MANAGEMENT [3]

The farmers recognize two broad soil divisions in Tillman County, namely, the sandy soils covering a belt about 10 miles wide east of North Fork Red River and continuing in a strip, ranging in width from 1 to 2 miles, along Red River, and the clay loam soils, or "tight land", of the remainder of the county.

No definite rotation is practiced to maintain the fertility of the soils. In the past, the price received for the best-adapted crops,

[3] This section of the report was written by W. C. Boatright, Oklahoma Agricultural Experiment Station

cotton and wheat, has resulted in only a small acreage being devoted to other crops. On the clay loam soils a rotation of cotton and wheat is used, but on many farms either one or the other of these crops is grown on the same land for several years in succession. The same practice is followed on the sandy soils as on the clay loam soils, but, as a rule, cotton is the principal crop. Because soil conditions in most of the sandy soils are most favorable for growing a diversity of crops, a rotation can be used for the purpose of maintaining soil fertility, especially as alfalfa can be included in the crop rotation. A crop rotation including alfalfa on the clay loam soils is not successful, as considerable difficulty is experienced in obtaining a profitable stand. It is generally recognized that alfalfa can be grown successfully only on the best land having proper soil and moisture conditions. Often the rainfall is not sufficient for good plant growth on the tight-land soils, and the tightness of the subsurface soil and subsoil hinders the development of the root system of deep-rooted plants like alfalfa.

The preparation and cultivation of the land is much the same throughout the county. Deeper plowing is practiced on the sandy soils than on the heavy soils, and the sandy soils may be plowed later because moisture conditions are better throughout the year. Land for wheat is plowed or listed in July, if moisture conditions are right, but if the land is too dry at this time, it is plowed later in the fall after rains. The land is usually harrowed after each rain, in order to prevent crusting of the soil and to pulverize it, thereby preventing so much evaporation of moisture. On many farms wheat is drilled between cotton rows in the fall. Land for oats is generally broken in late winter or early spring. Land for row crops, which consist mainly of cotton, corn, and grain sorghums, is usually bedded in the fall or winter with listers which make furrows 1 foot or more below the crest of the intervening ridges. At planting time the land is rebedded by running a lister down the ridges, making the new furrow with the ridges where the old furrows were, and the seed is planted in the bottom of the new furrow by many farmers at the same time the land is rebedded, as this method enables seed to be planted in moist soil. Plowing to a depth of 8 or 10 inches and disking once or twice is another good method and is started in January. Disk openers attached to planters are also used.

At each cultivation, except the last, soil is thrown around the roots of the cotton plants. At the last cultivation, the surface is left level or slightly higher around the plants than in the middles. Row crops are cultivated 3 or 4 times, and in some years cotton is cultivated more often. The young plants are cultivated with a go-devil, a kind of cultivator with flat metal wings that prevent the soil from going over the young plants as it is thrown in the furrows. Caution is taken to prevent blowing on the sandy soils by listing the land so that the furrows run east and west, or at right angles to the prevailing winds. It is sometimes necessary to replant crops where loose sands blow about so much as to destroy the young plants.

The practice of seeding the principal crops as early as possible is followed by most farmers. Cotton is planted between April 20 and July 1, but the best time is between May 10 and May 15, according to the experience of farmers over a period of years. Wheat is sown from September 1 to December 15, but early seeding, from September 10 to September 15, is best for winter pasture. When pastured with

good judgment the yields of grain are not materially reduced. Hard wheat is best adapted to the dry climate of this section. In years when moisture conditions are good cotton may follow wheat.

Oats are seeded from January 15 to March 10. The average yield is about 25 bushels an acre. Barley yields somewhat less than oats. It is also used for grazing, being sown at about the same time as wheat. Corn is planted between March 10 and March 15.

Land for alfalfa should be put in condition in July or August if moisture conditions allow, and the seed should be drilled in during August or September. Grimm and Common are the best adapted varieties. It may be necessary to inoculate the seed with soil from a field where alfalfa has been grown successfully or by using a prepared culture.

Blackhull kafir, Dwarf Yellow milo, hegari, feterita, and darso are popular forage crops. Grain sorghums make very little growth if the weather is cool and, therefore, should not be planted until danger of frost is over and the ground has warmed up. The best general practice to follow is to plant the seed as soon as the ground is sufficiently warm to insure germination.[4]

African millet and Red Top cane are grown as hay crops. They are drilled in in April but may be sown in the fall. Sudan grass is good for summer grazing or it may be cut for hay. It is planted in rows and cultivated. It withstands droughty weather rather well and with plenty of moisture yields from 1 to 3 tons of hay an acre from two cuttings.

Most of the land at present in cultivation has been producing crops for 30 years. Corn was the first crop grown in the county, and later, wheat, alfalfa, and cotton followed in importance. With the present system of cropping, which is principally growing cash crops, a large percentage of nitrogen and organic matter has been lost from the soil.

Commercial fertilizers have increased yields, but not enough to pay for the fertilizers, according to the report of the county agricultural agent. The growing of cash crops fails to promote the livestock industry, and as a result, very little manure is applied to the land. Observations of many wheat fields that have been pastured indicate that manure is very beneficial. Legume crops are not grown in the rotation systematically enough to lessen materially the drain on the soil by exhaustive farming. It is a common belief that yields have decreased about 20 percent on most soils of the county since they were brought under cultivation. The soil has been farmed for a comparatively short time and, doubtless, during dry seasons when yields are light, it is enabled to recuperate considerably. Farmers state that yields are usually better after a very dry year.

Soil erosion is another agency destructive to soil fertility. The damage is greatest on the more rolling clay loam soils, because the water does not penetrate the plastic clay subsoils, especially during heavy downpours. Moisture is absorbed readily in the sandy soils; hence, on them, erosion is not so great as on the more rolling clay loam soils, such as the Vernon and Tillman. The reddish-brown material of the surface layer is washed away in places and the red subsurface material is exposed. Land affected in this way is not productive, and crops suffer quickly during dry weather and produce small yields. Where the subsoil is exposed, the land is not cultivated so easily,

[4] BEESON, M A GRAIN SORGHUMS FOR OKLAHOMA. Okla Agr Col Ext. Circ 73, 13 pp, illus 1918

because the finer materials form a hard surface layer that is not so friable as in soils retaining the original surface soil material. Where the clay is exposed on the surface, it forms a sticky, waxy layer of material over the field and will puddle easily if cultivated when too wet.

Tillman County is in the 25-inch rainfall belt. The erosion survey conducted by the agronomy department of the Oklahoma Agricultural Experiment Station indicates that in this section about 15 acres of every 30 in the cultivated fields have some sheet erosion due to uncontrolled run-off of surface water, and that about 8 acres of every 30 in cultivation are gullied.

The system of farming that has been used for the last 30 years, in which more than 95 percent of the cultivated fields are planted to cash crops each year, has been decreasing the organic matter in the soil, thereby decreasing the power of the surface soil to hold soil moisture, has increased the percentage of run-off from the rainfall, and has increased erosion with losses of the topsoil through uncontrolled run-off of surface water.

The conservation of soil moisture may be accomplished by terracing the fields so that run-off will take place more slowly and a larger proportion of it will be absorbed and held in the soil. The use of leguminous cover crops for pasture and for plowing under is necessary to maintain and increase the supply of organic matter in the soil.

On most of the upland soils, scarcity of organic matter and nitrogen are the chief limiting factors in crop production, both of which may be supplied very economically by the use of sweetclover, Austrian winter peas, hairy vetch, cowpeas, and Mung beans. Soybeans also may be grown satisfactorily where protected from rabbits. The growing of more legumes is not only necessary for the maintenance of soil fertility but provides the best and cheapest feed for the livestock which should be kept to balance the agriculture and give a more safe and sane system of farming under varying economic conditions.

The chief dairy activity consists in producing cream for making butter rather than in producing whole milk for fluid use. An average of only about three cows a farm are kept. Dairying has been increasing because it contributes to diversification in farming which is essential throughout this section of the State. The lack of moisture and the tight character of many of the soils cause some difficulties in producing adequate quantities of suitable roughage. Good pastures are not so extensive as is desirable for best results in dairying, but concentrates can be produced in abundance by growing kafir, oats, and wheat.

## SOILS AND THEIR INTERPRETATION

The soils of Tillman County have been divided, in previous sections of this report, on the basis of certain common characteristics, into two major groups—the sandy soils and the clay loam soils. The sandy soils occur only in the western and southern parts of the county, which are designated as the western belt, and the clay loam soils occupy the rest of the county, known as the eastern belt.

The clay loam soils are derived from weathered clay and shale, which develop a very fine textured surface material, and the sandy soils are developed on sandy deposits which do not readily decompose through weathering.

The clay and shale from which the clay loam soils are derived are considered by geologists [5] as marine deposits which developed a comparatively smooth surface over the area, but after the sea had receded, the material eroded very rapidly so that a very small proportion, if any, of the original surface soil material was left undisturbed to be developed into a normal soil profile. As a result of this extensive erosion most of the weathered material has been transported to the lower slopes or valleys, leaving the unweathered material exposed on the surface. Wherever a part of the area was flat or gently rolling so that erosion had very little effect on the surface soil, the weathered material accumulated to considerable thickness.

Geologically considered, the sandy material from which the sandy soils were developed is of comparatively recent deposition and has not been modified on the surface to any extent through stream erosion, as compared with the surface soil in the area of the clay loam soils, but wind has played an important part in the modification and transportation of this sand deposit, so that, probably, only a very small part of the original surface soil has been undisturbed. In the extreme western and southern parts of the county are areas in which wind has heaped the sand into dunes. Where the surface relief has not been altered to an appreciable extent by wind or water erosion, the land is flat or gently rolling.

In the level or undulating sections of the county, in either belt in which these soil groups occur, climate and vegetation have had their greatest influence on the soil-forming processes, because the conditions are such as do not disturb or destroy the changes that are taking place in the soil. After a long period the soils have developed certain common characteristics, one of which is the dark color of the surface layer, except where recent surface erosion may have removed it; and another is the accumulation of carbonates, mainly calcium carbonate, in the lower part of the subsoil. The dark color of the surface soil is caused by organic matter supplied through decay of grasses.

As determined by tests with hydrochloric acid, calcium carbonate makes its first appearance at an average depth of 18 inches below the surface in the clay loam soils, in the form of concretions or finely disseminated particles. In most places it is most abundant between depths of 60 and 72 inches, where the concretions are larger and much of the calcium carbonate is in the form of soft floury material. This may be the zone of lime accumulation within the soil profile of the clay loam soils. Lime first appears at a greater depth below the surface in the sandy soils, including only those occupying flat areas. In most places it is present at a depth of 60 or more inches, occurring within a gray clay material either in the form of concretions or finely disseminated.

Soils with the characteristics described above may be regarded as having developed a typical regional profile and are, therefore, the mature soils of the county. The soils identified with the Foard, Kiowa, Tillman, and Calumet series of the clay loam soils, and Tipton very fine sandy loam and Enterprise very fine sandy loam of the sandy soils have the dark surface soil and the zone of lime carbonate accumulation, but they differ from each other in amount of clay accumulated in the subsoil or in degree of darkness of the surface soil.

[5] See footnote 1, p 1.

Soils which have been mapped in parts of the county where the surface is altered by water or wind erosion have not developed the typical regional profile and are regarded as immature because the changes that were developing in the soil material through the influence of climate and vegetation were destroyed. The characteristics of these immature soils are developed mainly through the influence of local environment. Where the soils are immature on account of insufficient time for maturing, the surface layer consists mostly of sandy material that is either resistant to the soil-forming processes or has been very recently deposited. Another local condition producing an immature soil is excessive surface erosion.

Foard silt loam is representative of the dark-colored soils of the clay loam group. Its most extensive occurrence is southeast of Frederick, but it also occurs in other parts, in areas in which the surface relief is smooth and gently rolling and the land well drained. A road cut in an area of Foard silt loam along the south line of sec. 8, T. 3 S., R. 16 W., reveals the following profile characteristics: The topmost layer of the profile is very dark grayish-brown or brown material to a depth of about 18 inches, where it passes into a yellowish-brown horizon which continues downward to a depth of 36 inches. Below this depth the material is reddish yellow, and it continues to a depth of 50 inches, where it is underlain by red plastic clay of the Permian "Red Beds." Each of the three horizons in the profile of Foard silt loam differs from the others in certain characteristics and may be further divided into several layers.

In the first horizon is a laminated layer, about 1 inch thick, which consists of very friable single-grained material. It is formed by numerous platelike or disklike very fragile overlapping particles averaging about one-sixteenth inch in thickness and one-tenth inch in diameter. This layer is, perhaps, developed from wind-blown deposits between the grass roots. Below this layer the material, when removed with a spade, breaks from the soil wall in columnar form, owing, perhaps, to the mass of grass roots that penetrate it. The material then breaks into small irregular-shaped particles that range from one-sixteenth to one-half inch in diameter and are easy to crush by hand when moist but very hard when dry. A faint sprinkling of gray is detected on the material to a depth of 6 or 7 inches. Below this depth the remainder of the horizon contains a greater accumulation of clay than the upper part. The material is very hard when dry, breaking into irregular-shaped pieces with sharp corners, and it is black or brown in color.

The second horizon consists of yellowish-brown material which is the most compact part of the profile and is referred to by many as a claypan. The material is plastic and sticky when wet, but when dry it forms hard sharp angular clods that range from one-half inch to 2 inches in diameter. Embedded within the material are many hard carbonate concretions and brown pellets. The pellets range from one-fourth to one-half inch in diameter, and the interior part consists of yellowish-brown fine material.

The third horizon consists of reddish-brown material in which less difficulty is usually experienced in boring with an auger than in the material of the horizon above, due either to the material being more friable or more moist. This horizon contains a greater amount of

45619—35——4

visible lime carbonate than the material either above or below it and may represent the zone in which lime has accumulated through leaching from the upper parts of the profile. The carbonates are in the form of hard concretions and soft splotches, the concretions being two-fifths inch or smaller in diameter. They are hard to crush and when crushed reveal a small cavity in the interior. Many of these concretions are surrounded by white powdered material that may be the disintegrated part of the concretion. Table 4 gives the pH values of the material in the different layers of the profile of Foard silt loam and other soils of the clay loam group and sandy soils group. This table shows, in all soil types in which the pH values were determined, a gradual increase in lime content with increased depth, but the most noticeable increase occurs within the third horizon. Below the third horizon, most of the soil types of the clay loam group, except Foard silt loam, reveal a decrease in the amount of lime as indicated by the pH values. Foard silt loam probably would have shown a decrease in lime content below the third horizon if sampling had been continued to a greater depth.

TABLE 4.—*pH determinations of several soils in Tillman County, Okla.*

| Soil type and sample no. | Depth | pH |
|---|---|---|
| | *Inches* | |
| Enterprise loamy fine sand: | | |
| 451070 | 0- 6 | 7.83 |
| 451071 | 6-14 | 7.52 |
| 451072 | 14-30 | 7.42 |
| 451073 | 30-55 | 7.42 |
| 451074 | 55-80 | 7.59 |
| 451075 | 80-90 | 7.50 |
| Tillman silt loam: | | |
| 451082 | 0- 4 | 7.25 |
| 451083 | 4-14 | 7.20 |
| 451084 | 14-30 | 7.44 |
| 451085 | 30-60 | 8.42 |
| 451086 | 60-90 | 8.00 |
| Tipton very fine sandy loam: | | |
| 451097 | 0- 8 | 7.59 |
| 451098 | 8-18 | 7.57 |
| 451099 | 18-42 | 8.15 |
| 451100 | 42-72 | 8.39 |
| 451101 | 72-90 | 8.34 |
| Kiowa clay: | | |
| 451001 | 0- 1 | 8.00 |
| 451002 | 1-12 | 7.75 |
| 451003 | 12-24 | 8.55 |
| 451004 | 24-60 | 8.75 |
| 451005 | 60-86 | 8.94 |
| 451006 | 86+ | 8.42 |
| Calumet very fine sandy loam: | | |
| 451007 | 0- 4 | 7.00 |
| 451008 | 4-10 | 6.93 |
| 451009 | 10-16 | 7.59 |
| 451010 | 16-20 | 8.05 |
| Calumet very fine sandy loam—Continued: | | |
| 451011 | 20-36 | 7.89 |
| 451012 | 36-66 | 8.02 |
| 451013 | 66-76 | 8.51 |
| 451014 | 76-84+ | 8.65 |
| Foard silt loam: | | |
| 451021 | 0- 3 | 7.79 |
| 451022 | 3-10 | 8.02 |
| 451023 | 10-18 | 8.72 |
| 451024 | 18-36 | 8.95 |
| 451025 | 36-50 | 8.00 |
| 451026 | 50-74+ | 8.27 |
| Randall clay: | | |
| 451046 | 0- 1 | 7.30 |
| 451047 | 1-10 | 8.09 |
| 451048 | 10-30 | 8.37 |
| 451049 | 30-60 | 8.55 |
| 451050 | 60+ | 9.07 |
| Tillman very fine sandy loam: | | |
| 451051 | 0- 6 | 7.23 |
| 451052 | 6-10 | 7.52 |
| 451053 | 10-18 | 8.77 |
| 451054 | 18-40 | 8.63 |
| 451055 | 40-84+ | 8.72 |
| Enterprise very fine sandy loam: | | |
| 451065 | 0- 6 | 7.72 |
| 451066 | 6-20 | 7.27 |
| 451067 | 20-42 | 7.35 |
| 451068 | 42-55 | 7.47 |
| 451069 | 55-72 | 8.39 |

The third horizon merges into the parent material of the Permian "Red Beds." These beds consist of red clay which is plastic when wet and very hard when dry. It contains finely disseminated lime and only a few lime concretions. Most of the material is uniform in color, but in places it is mottled or spotted with yellow, rust brown, and bluish gray.

Foard clay differs from Foard silt loam in that the surface material is heavier in texture. It is confined to more level areas than those occupied by Foard silt loam. All the areas are flat, and drainage may be slow. The most extensive bodies of Foard clay are in the vicinities

of Loveland and Tillman. Land of this kind is locally known as "onion land."

A description of the profile of this soil observed near the northeast corner of sec. 23, T. 3 S., R. 15 W., is as follows: The surface layer consists of very dark grayish-brown material which grades, at a depth of 20 inches, into yellowish-brown material spotted with lime carbonate concretions. This layer, in turn, continues downward and the material changes, at a depth of 48 inches, into somewhat pink or salmon-red material containing an abundance of lime concretions.

The first horizon consists of material which is very plastic when wet and hard when dry. When removed in a dry condition, it breaks into large pieces that range from one-half to 1 inch in diameter. The topmost material in many places develops a decidedly granular structure when dry, and a loose porous consistence is developed to a depth of about 3 inches. In this condition, well-defined footprints may be made on the surface by walking across a field that has been summer fallowed.

The material in the second horizon is very compact and is very similar in detail to the corresponding horizon of Foard silt loam.

The third horizon contains material that is slightly more friable than the material in either the first or second horizons. Lime carbonate is most abundant in the upper part but decreases with depth.

Kiowa clay is variable in color over the surface, ranging from very dark grayish brown to reddish brown. Small patches ranging from 6 to 12 feet in diameter have reddish-brown surface material and they occur at more or less regular intervals of 50 or 60 feet. Many of them are linked together so as to form narrow strips, this condition being very noticeable over virgin areas where there is a difference in the vegetal growth prevailing on the dark-colored surface soil and that on the red surface soil. Across the virgin areas, bunch grass predominates on the belts of reddish-brown soil, and shorter grasses, especially buffalo grass and grama grass, grow on the darker colored soil. The reddish-brown patches may have been formed by burrowing animals, as the soil here consists of material that typically occurs in the lower part of the profile. This reddish-brown material is calcareous and contains an abundance of lime concretions which are strewn over the surface. In many places the reddish-brown material has been distributed over the surface as a result of cultivation and leaves the impression that the entire area is naturally calcareous.

A profile examined in the northwestern corner of sec. 18, T. 1 S., R. 15 W., shows the following characteristics of Kiowa clay having the darker colored surface soil. To a depth of 1 inch the surface soil is of very fine texture and can be easily crushed into fine powder. It has a laminated structure which in many places is so faintly developed that it is not easily detected, and a very slight disturbance destroys any structure that the material may have. Beneath this surface layer the material forms a horizon of more perfect granulation as compared with the material in a corresponding horizon in the profile of any other soil in Tillman County. When removed, the material breaks up into aggregates which increase in size with depth and become less distinct in outline, especially where the material merges with another horizon of heavier material. The aggregates range in diameter from one-sixteenth inch in the upper part of the horizon to one-half inch in the lower part. The material in this horizon is very dark grayish

brown, but in many places it appears black when moist. In the upper 6 inches of the horizon, the crushed aggregates do not change from the color shown on the faces, but in the lower part they have a yellow shade, indicating that the material in the upper part is more thoroughly impregnated with organic matter than that in the lower part.

This granular horizon merges at a depth of 12 inches into a second horizon which consists of the most compact material in the profile. The material when moist is removed in large structureless pieces that average between 4 and 6 inches in diameter. They present a jagged surface spotted with a black shiny film. When dry, this material breaks into large clods which require considerable effort to break or crush by hand. The second horizon extends to a depth of 24 inches. The color ranges from very dark grayish brown in the upper part to a more yellow shade in the lower part. The material is penetrated by a few roots, principally the primary roots of grasses and larger plants. Embedded in the material are a few black pellets, averaging about one-fifteenth inch in diameter, which are easily crushed into a brown fine powder. As determined by tests with hydrochloric acid, lime occurs at a depth of 15 inches in concretionary form and also in disseminated form. The concretions range in size from a pinhead to one-tenth inch in diameter. They are irregular in shape, ranging from flat to somewhat spherical, and are separately embedded within the material. Most of the larger concretions are surrounded by numerous tiny pieces of concretions and have the appearance of being in the process of disintegration or formation.

The third horizon consists of grayish-yellow material that is plastic when moist and very hard when dry. With the exception of calcareous sandstone or limestone that occurs in places, this material is uniform in character throughout its entire depth.

To a distance of 60 feet away from the place where the profile described was observed, a gradual change in profile characteristics takes place, and at this distance the reddish-brown surface soil prevails. Lime, as determined by tests with hydrochloric acid, occurs in the brown or reddish-brown surface horizon. This layer grades at a depth of 14 inches into yellowish-brown plastic clay which continues downward to a depth of 24 inches, where it grades into reddish-brown or grayish-yellow clay.

Kiowa clay occurs in large areas in the northeastern part of Tillman County, extending a short distance into the southeastern corner of Kiowa County. This soil in this section has been identified as belonging to the Kiowa series because of certain characteristics that do not prevail in soils in other parts of the county. One of these characteristics is the decidedly granular structure of the material in the dark-colored surface horizon; the second is the calcareous condition of much of the surface material; the third is that bunch grass in many places is the predominant grass vegetation, whereas grama and buffalo grass are the principal grasses on the Foard soils; and the fourth is that an entirely different kind of parent material underlies this soil, compared with the parent material underlying the Foard soils. In many places calcareous sandstone and limerock underlie this soil, whereas the red clay of the Permian "Red Beds" underlies the Foard soils. In a profile examined in sec. 8, T. 1 S., R. 14 W., yellowish-white calcareous material occurs at a depth of 50 inches below the surface, and at a depth of 66 inches limerock is reached.

Calumet very fine sandy loam is predominately grayish brown on the surface. This color is most conspicuous wherever the soil is developed among the darker colored soils in Tillman County. The color of the Calumet soils is not uniformly developed over the surface, and spots of reddish brown occur here and there. However, the color is uniform where the surface soil is deepest. This layer ranges from 3 to 10 inches in thickness. Near the top the material is laminated, and in the lower part it forms small cubical blocks. The laminated material is formed of tiny platelike overlapping pieces one-twelfth inch or less in thickness and one-half inch in diameter. The plates are very fragile, making it difficult to determine their size. The blocks in the lower part of the horizon are from 1 to 2 inches in diameter. When the material is wet, the structure is entirely destroyed. As indicated by the light color of the soil, the organic content is low. Near the surface and in the lower part of the horizon the color is slightly darker, owing, perhaps, to the fact that more organic material has accumulated. At the top the organic matter is derived from decaying grasses, and in the lower part it is derived from the organic matter that has been leached through the material and prevented from further leaching by the heavy claypan horizon below. The material in the upper part of the horizon does not show any appreciable change in color when crushed, but in the lower part it changes to brown. The surface horizon rests on the commonly termed heavy claypan horizon that is either very dark grayish brown, black, or reddish brown. Along road cuts these colors occur alternately in the horizon and, in places, either black or reddish brown predominates in the claypan horizon for considerable distances. As observed in a deep cut in the southwest corner of sec. 35, T. 1 S., R. 15 W., the upper part of this claypan horizon is very dark grayish-brown material grading into reddish brown in the lower part.

The material in the claypan horizon is extremely hard when dry and plastic when wet. Where the color is black the material is usually much harder than where the color is reddish brown. When removed with a spade the material breaks into large irregular-shaped pieces which when moist have a shiny surface in spots. Along natural lines of breakage the faces of these large pieces have small roots pressed into the material. On drying in place the material cracks vertically, forming a columnar structure. The tops of the columns are level and square cornered, and the surfaces of the broken ends of the columns are rather smooth and free of jagged or broken material. Any irregularities on the surface are clearly defined. Embedded in the material are small brown or black carbonaceous pellets, averaging one-twelfth inch in diameter, which are easily crushed to a brown powder. On the hard crust of a freshly broken surface, tiny pores, which, probably, are root cavities, are seen.

The claypan horizon gradually merges into a yellowish-red horizon, in which the material is more friable, as determined by the ease with which it is penetrated with a spade. This friable condition probably accounts for the greater amount of moisture in the material than in the claypan horizon above, and even after a long, dry season, an appreciable amount of moisture is in this part of the profile. This horizon begins at an average depth of 18 inches and continues to a depth of 36 inches. Embedded within the material are white specks of lime in the form of concretions, and around each concretion is a

soft somewhat white material composed of either lime or gypsum. This white material is very soft and is easily reduced to powder. Most of the material throughout this horizon is calcareous, but some of that between the lime concretions does not effervesce with acid. Thin seams of gypsum and some black carbonaceous pellets, similar to those in the horizon above, occur in many places.

Below a depth of 36 inches the material grades into a horizon of yellowish-red or red clay. A few lime concretions occur, but the material between the concretions does not effervesce with hydrochloric acid. This material is easily penetrated with a spade or auger. Continuing to an average depth of 60 inches, this horizon passes into a thin horizon which consists of pink or salmon-colored very friable material as compared with any of the material below the claypan horizon. It contains an abundance of lime, both in concretions and in powdered form, the concretions averaging two-fifths inch in diameter. This is the horizon of lime-carbonate accumulation, below which, at an average depth of 72 inches, is red or brick-red very fine sandy loam that is very moist and is, apparently, very near the water table. This material is calcareous, but only a few lime concretions occur.

An excavation made along the north line of sec. 29, T. 2 S., R. 16 W., shows a profile similar to the one described. This profile is divided into six different-colored horizons. The first two are distinctly separated, but those in the remainder of the profile gradually merge into each other so that the color of each horizon blends with that of the next, making the line of separation arbitrary. The first horizon, which extends to an average depth of 10 inches, is gray, and the second is chocolate brown or reddish brown, making a sharp contrast in the colors of the two. The second horizon is known as the claypan horizon. Continuing downward through this, the color changes gradually to a lighter shade. At a depth of 20 inches is the third horizon, in which the color of the material is yellowish red, and specks of lime and gypsum occur. This horizon extends to a depth of 36 inches, at which depth the fourth horizon begins. This horizon is yellowish red or red and is similar in structure to the horizon above. Within the material are a few concretions of lime and seams of gypsum, but not so numerous as in the horizon above. This horizon continues downward to a depth of 66 inches. The next horizon, the fifth, is pink or salmon and contains an abundance of lime concretions, more concretions occurring here than in any other part of the profile. This horizon is about 10 inches thick, and below it, continuing to a depth of 84 inches (the depth of excavation), is red clay containing considerable very fine sand. As far as could be observed in deeper cuts, the clay continues to a great depth. In the excavation made, the material was moist at a depth of 84 inches and was apparently near the water table. The material effervesced slightly with acid, and a few concretions were present. Grass roots were present on the freshly broken surface of the profile down to a depth of 20 inches, or through the first and second horizons. Further investigation, made by breaking away a piece of soil material, seems to indicate that most of the roots follow the natural lines of breakage. On the surface along which natural breakage occurs, the roots appear to be pressed against the surface.

A noticeable difference in the character of the material, on surfaces exposed to weathering, occurs between each of the first three horizons, but in the remainder of the profile, including the lower three horizons,

the structure is the same. When the exposed surface of the profile is dry, the first horizon is smooth and compact, and a thin hard crust is developed on top. No cracks develop through the effects of drying. In the claypan horizon the material cracks vertically and forms columns 3 or 4 inches thick. In the third horizon and in the remainder of the profile, the material on the exposed surface cracks horizontally and vertically with no apparent regularity, and pieces removed from the exposed surface are irregular in shape and size. In many places this part of the profile has, seemingly, a higher percentage of moisture than the first two horizons of the upper part of the profile, and the true structure of the material is not readily revealed. The material is easily penetrated with an auger or spade, owing, probably, to its moist condition. Where the surface crust of the first horizon is broken, the material is easily penetrated with a spade because of its friability. The second horizon, called the claypan, is the most difficult to penetrate, owing to its high clay content and cementing properties.

The principal characteristics that distinguish the Calumet soils from the Foard soils include the gray surface soil, the underlying claypan horizon, and the extreme hardness of the material in the claypan horizon.

The Calumet soils occur on low flat areas that include high bench lands, which may be called ancient terraces, of the larger streams of the county. In many places they form a narrow strip bordering large flat areas that are predominately occupied by Foard clay. The best illustration of this is on areas known as "onion land" or "onion flats."

Under cultivation the Calumet soils lose their granular structure and run together. That is, the topmost surface soil in cultivated fields disperses readily when wet after a heavy rainfall and on drying forms a hard crust. The hard crust makes it extremely difficult for the tender shoots of crop plants to penetrate the surface, and yields are not so large as they otherwise would be. When cultivated in a dry condition the surface layer forms platelike clods that average one-half inch in thickness and 3 inches in diameter. Observations in wheat fields show that cracks formed on the surface as a result of drying usually follow the furrow formed by the grain drill at the time the crop was seeded, and on the ridges between the rows of growing grain the surface material is usually hard and free of cracks.

Tillman very fine sandy loam has profile characteristics that are very similar to those of Calumet very fine sandy loam, but the Tillman soil has a thicker and redder surface soil This soil is developed around Grandfield in the southeastern part of the county where sandstone forms the underlying parent material. In many parts of the area covered by the Tillman soils, farmers report that sandstone is reached at a depth of 25 feet in well-digging operations.

A profile of this soil as observed in the northern part of sec. 2, T. 4 S., R. 14 W., has the following characteristics: The surface horizon, which is about 10 inches thick, breaks up into loose structureless very fine sand. In the upper 6 inches it has a laminated structure, caused by the overlapping of many platelike particles. In the remainder of the horizon the material breaks into blocks that range from 1 to 2 inches in diameter. The surfaces of these blocks contain numerous pores which, perhaps, are abandoned root cavities.

The first horizon rests abruptly on a horizon of reddish-brown material which is very hard and intractable when dry, breaking into

large irregular-shaped lumps which cannot be broken into smaller aggregates by hand. This material continues downward to a depth of 18 inches, where it grades into material which contains numerous lime-carbonate concretions and brown pellets embedded within the material. At a depth of 48 inches is the third horizon of red clay which is not so calcareous as the material in the horizon above, according to the degree of effervescence produced by test with hydrochloric acid. The material in this horizon is mottled with yellow and rust brown and contains fragments of red sandstone.

Tillman silt loam may be included in a subgroup of the clay loam group of soils, in that, in many places, it does not have so dark a surface soil as the Foard and Kiowa soils. It includes areas in which the surface is more sloping than that of the areas occupied by the Foard soils, hence, surface erosion is apt to be more active on the Tillman soil than on the Foard soils, and as a result the dark organic material has been constantly removed and the subsurface soil, which has accumulated very little organic material, is exposed. In a profile of this soil observed in sec. 25, T. 2 S., R. 17 W., the surface horizon is brown or chocolate-brown friable material grading at a depth of 18 inches into a redder horizon of compact clay which continues downward to a depth of about 40 inches, where it passes into the third horizon consisting of friable reddish-brown or red material spotted with yellow and bluish gray. Lime, in concretions and in disseminated form, occurs in the second horizon at a depth of 18 inches, the concretions being most abundant in the lower part of the horizon. With increased depth below 40 inches the concretions become less numerous, although the material, to a depth of 90 inches, is calcareous in reaction when tested with hydrochloric acid. With the exception of the reddish-brown surface horizon, Tillman silt loam is very similar to Foard silt loam in structure of the different horizons.

Tillman very fine sandy loam is the other soil mapped in the Tillman series. It differs from Tillman silt loam chiefly in the texture of the surface material, as indicated by the type name.

Enterprise very fine sandy loam represents the most normally or maturely developed soil of the sandy soil group of Tillman County. This soil is developed in areas having flat or gently rolling surface relief. Surface drainage is good, although a few wet depressions occur in places where run-off water collects, as no drainage channels are on this land.

Examinations of Enterprise very fine sandy loam made in different parts of the county show that the profile may be divided, on the basis of color, into three horizons which merge into each other. The first horizon is brown or very dark grayish-brown very fine friable material. The second, which lies between depths of 18 and 40 inches, consists of brown material with a red shade, that is finer in texture—silty clay or clay loam. The third consists of gray clay, and it continues downward from the second horizon to a depth of 84 or more inches. At a depth of about 60 inches the material is calcareous, lime occurring both in concretions and in finely disseminated form. In some places on the more rolling areas, the material throughout the entire profile may be more friable than in the profile just described, but the number of horizons, their color and thickness, and the lime content in the lower part of the third horizon are similar.

Tipton very fine sandy loam usually occurs on more level areas than Enterprise very fine sandy loam and also appears to occupy an old

terrace position. It differs from Enterprise very fine sandy loam in that the surface soil is slightly darker and that lime occurs at less depth. As observed in sec. 3, T. 1 S., R. 19 W., the profile consists of three horizons which merge into each other. The first horizon is very dark grayish brown or almost black to a depth of 24 inches. It grades into the second horizon which continues downward to a depth of 42 inches and consists of brown or yellowish-brown friable clay loam. Below this is gray calcareous friable clay which continues downward to a depth of 90 or more inches. Lime occurs in both concretionary and disseminated form.

The first group of immature soils in Tillman County includes soils in which insufficient time has elapsed for complete soil development because their surface material is either resistant to the soil-forming processes or has been recently deposited. Where the surface material is resistant to weathering, this group includes most of the soils of the sandy group, including the soils of the Enterprise series and areas mapped as dune sand. These soils have brown or reddish-brown surface soils and a profile that may be divided into three separate horizons. The first horizon is composed of brown or dark reddish-brown very friable sandy material which grades, at a depth ranging from 6 to 12 inches, into a second horizon of lighter reddish-brown friable material. This passes, at a depth of 36 or 40 inches, into the reddish-brown friable material of the third horizon, which usually contains more clay than the material in the upper horizons. The material in the third horizon, judged by its feel when wet, is sandy clay. None of the material in the profile effervesces with acid.

Enterprise loamy very fine sand has a grayish-brown loose friable surface soil which passes downward, at a depth of 10 inches, into brown or reddish-brown material that is similar in structure to that of the surface horizon. This continues downward to a depth of 42 inches, where it passes into a horizon of reddish-brown friable sandy clay that extends to a depth of 72 inches, and this, in turn, passes into reddish-brown fine sand.

In some places the surface soil of Enterprise loamy very fine sand consists of dark reddish-brown incoherent material which, at a depth of 6 inches, grades into reddish-brown material similar in character to the surface soil. It extends to a depth of 36 inches, below which it passes into friable sandy clay that extends downward to a depth of 60 inches. This layer is underlain by yellow fine sand. This variation differs from the typical loamy very fine sand in that it has a redder, more friable surface soil, and in places mounds have formed over the surface.

The surface soil of Enterprise loamy fine sand is gray or grayish-brown friable loamy fine sand that passes downward, at a depth of 6 inches, into reddish-brown sandy clay loam of very similar structure. This material continues to a depth of 30 inches, where it merges into reddish-brown sandy clay or fine sandy loam, which continues to a depth of 90 or more inches with no apparent change. This soil differs from its flat phase in that the surface soil is lighter in color and is thinner.

Enterprise loamy fine sand, flat phase, has a dark-brown or brownish-gray loamy fine sand surface soil that passes downward, at a depth of 15 inches, into reddish-brown friable material which is similar in structure. This extends to a depth of 40 inches and passes into reddish-brown material that contains sufficient clay to produce a sandy clay texture, which continues to a depth of about 90 inches with

no change in character. The flat phase differs from the typical soil in that the surface soil contains more coarse material and is slightly darker.

The surface soil of Enterprise sand is composed of gray incoherent sand which grades, at a depth of 6 inches, into reddish-brown loose incoherent sand. This continues to a depth of 80 or more inches without any change in color or structure. This soil differs from the other Enterprise soils in that the lower subsoil layer does not contain sufficient clay to produce a sandy clay texture, such as occurs in most of the soils of the Enterprise series. Enterprise sand is a transitional soil between dune sand and the more stable sandy soils. It has a more or less unstable surface soil which drifts easily when unprotected by growing crops, but where the land is carefully handled to prevent soil drifting, crops can be successfully grown.

Dune sand consists of gray loose fine sand which is light brown when moist. The gray material extends to a depth of about 4 inches and grades into loose incoherent reddish-yellow or reddish-brown sand. The surface soil drifts easily, and most of it has been piled into dunes. Wherever the surface is disturbed considerably, the drifting material covers the nearby growth of vegetation.

The soils of the second group of immature soils, immaturely developed because of recent deposition of the material, occur in the valleys. They include soils of the Miller, Yahola, and Portland series, and areas mapped as river wash.

The soils of the Miller series have reddish-brown or chocolate-brown surface soils that grade into chocolate-brown subsoils which continue downward with very little change in character. In most places the material in both the surface soil and subsoil effervesces with acid.

The soils of the Yahola series have reddish-brown or dark-brown surface soils grading, at a depth ranging from 6 to 12 inches, into friable very fine sandy material or coarse sand. Both the surface soils and subsoils are calcareous.

The Portland soils have dark-brown or brown surface soils that grade, at a depth ranging from 6 to 12 inches, into chocolate-brown clay subsoils which extend to a depth of 60 or more inches. These soils differ from the Miller soils in that the surface soils are darker and the surface soil and subsoil do not effervesce with acid.

River wash consists of recently deposited gravelly material that lies a few feet above the present river bed. In most places the land is barren of vegetation.

The third group of immature soils, consisting of those soils that were influenced in their development by excessive moisture conditions or severe erosion, includes the Randall and Vernon soils of the clay loam group.

Randall clay, the only soil of the Randall series mapped in Tillman County, has developed under excessive moisture. The surface soil consists of dark-gray or dark grayish-brown plastic clay that grades, at a depth of 10 inches, into gray plastic sticky clay which continues downward and merges into red clay at a depth of 48 inches. The material throughout the entire profile effervesces with acid.

The Vernon soils are developed under more or less eroded conditions. Vernon clay loam has a red or reddish-brown surface soil which is very sticky when wet, and when dry, large cracks open in the material. This passes, at a depth of 4 or 5 inches, into a tough plastic red clay subsoil. In many places the material in both the surface soil and subsoil

is calcareous, and the material everywhere is calcareous within 6 or 8 inches of the surface. Vernon very fine sandy loam differs from Vernon clay loam only in texture of the surface soil. The eroded phase of the clay loam represents areas where the surface is cut by gullies, and the parent material is exposed over a large part of the area.

In places areas of soil occur which are very similar in character to the eroded phase of Vernon clay loam, except that the soil is yellowish brown instead of reddish brown. This difference in color is owing to the fact that the soil in these areas is derived from an entirely different colored parent material. The surface soil consists of yellow granular clay passing, at a depth of 12 inches, into stiff plastic yellow clay. The material throughout the profile is calcareous.

Table 5 gives the results of mechanical analyses of several soils in Tillman County.

TABLE 5.—*Mechanical analyses of several soils from Tillman County, Okla.*

| Soil type and sample no. | Depth | Fine gravel | Coarse sand | Medium sand | Fine sand | Very fine sand | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| Enterprise very fine sandy loam: | *Inches* | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* |
| 451065 | 0- 6 | 0.0 | 1.5 | 4.1 | 10.0 | 29.6 | 36.7 | 18.0 |
| 451066 | 6-20 | .0 | 1.6 | 4.6 | 10.5 | 28.6 | 40.3 | 14.3 |
| 451067 | 20-42 | .1 | 1.6 | 4.3 | 10.3 | 27.7 | 30.6 | 25.3 |
| 451068 | 42-55 | .1 | 1.7 | 4.1 | 9.0 | 28.1 | 32.4 | 24.7 |
| 451069 | 55-72 | 1.5 | 3.3 | 4.3 | 9.7 | 23.2 | 28.5 | 29.5 |
| Enterprise loamy fine sand: | | | | | | | | |
| 451070 | 0- 6 | .2 | 6.5 | 17.5 | 29.6 | 27.9 | 12.3 | 6.0 |
| 451071 | 6-14 | .4 | 6.7 | 15.8 | 21.0 | 23.5 | 8.5 | 24.0 |
| 451072 | 14-30 | .2 | 7.5 | 18.5 | 25.9 | 21.9 | 16.6 | 9.3 |
| 451073 | 30-55 | .2 | 5.7 | 15.4 | 19.3 | 26.7 | 13.9 | 18.8 |
| 451074 | 55-80 | .2 | 5.1 | 12.2 | 17.2 | 21.9 | 21.0 | 22.3 |
| Tillman very fine sandy loam: | | | | | | | | |
| 451051 | 0- 6 | .1 | .2 | .3 | 5.4 | 22.8 | 50.7 | 20.5 |
| 451052 | 6-10 | .1 | .1 | .2 | 5.1 | 24.2 | 52.2 | 18.0 |
| 451053 | 10-18 | .0 | .1 | .2 | 4.0 | 15.4 | 39.5 | 40.7 |
| 451054 | 18-40 | .1 | .2 | .2 | 3.4 | 14.0 | 41.2 | 40.8 |
| 451055 | 40-84+ | .5 | .6 | .3 | 3.5 | 13.7 | 38.4 | 42.9 |
| Tipton very fine sandy loam: | | | | | | | | |
| 451097 | 0- 8 | .1 | 2.2 | 5.3 | 8.5 | 28.5 | 38.5 | 16.8 |
| 451098 | 8-18 | .0 | 2.2 | 5.8 | 8.9 | 27.8 | 35.7 | 19.5 |
| 451099 | 18-42 | .2 | 2.9 | 6.5 | 10.8 | 23.7 | 32.9 | 22.9 |
| 451100 | 42-72 | .4 | 1.7 | 3.6 | 7.6 | 16.1 | 33.9 | 36.6 |
| 451101 | 72-90 | .3 | 1.7 | 4.1 | 7.7 | 18.9 | 32.1 | 35.3 |
| Foard silt loam: | | | | | | | | |
| 451021 | 0- 3 | .1 | .2 | .2 | 1.1 | 7.2 | 59.2 | 31.9 |
| 451022 | 3-10 | .0 | .2 | .2 | .9 | 5.7 | 47.6 | 45.3 |
| 451023 | 10-18 | .3 | .3 | .3 | 1.1 | 5.9 | 45.7 | 46.3 |
| 451024 | 18-36 | .2 | .4 | .4 | 1.1 | 5.7 | 46.6 | 45.6 |
| 451025 | 36-50 | .5 | .5 | .3 | 1.1 | 5.4 | 45.3 | 46.9 |
| 451026 | 50-74+ | .5 | .7 | .5 | 1.5 | 6.1 | 41.3 | 49.4 |
| Foard clay: | | | | | | | | |
| 451015 | 0- 6 | .1 | .2 | .2 | 1.3 | 6.7 | 48.3 | 43.1 |
| 451016 | 6-12 | .1 | .2 | .2 | .9 | 5.3 | 45.6 | 47.8 |
| 451017 | 12-20 | .1 | .1 | .1 | .8 | 6.6 | 45.4 | 46.9 |
| 451018 | 20-48 | .6 | .9 | .8 | 1.4 | 5.0 | 35.9 | 55.4 |
| 451019 | 48-60 | .4 | .3 | .3 | .7 | 5.0 | 43.0 | 50.2 |
| 451020 | 60-96+ | .0 | .1 | .1 | .8 | 5.9 | 45.4 | 47.6 |
| Kiowa clay: | | | | | | | | |
| 451001 | 0- 1 | 1.1 | 1.7 | 1.1 | 2.0 | 7.4 | 47.8 | 38.9 |
| 451002 | 1-12 | .8 | 1.2 | .8 | 1.5 | 5.8 | 46.8 | 43.1 |
| 451003 | 12-24 | 1.3 | 1.5 | .9 | 1.5 | 4.0 | 43.2 | 47.7 |
| 451004 | 24-60 | 2.0 | 1.9 | .9 | 1.2 | 2.7 | 28.3 | 63.0 |
| 451005 | 60-86 | .9 | 1.2 | .7 | .9 | 2.7 | 38.5 | 55.1 |
| 451006 | 86+ | .5 | .5 | .6 | 1.6 | 2.5 | 26.8 | 67.6 |
| Tillman silt loam: | | | | | | | | |
| 451082 | 0- 4 | .1 | 1.3 | 1.7 | 2.3 | 15.2 | 57.8 | 21.5 |
| 451083 | 4-14 | .3 | 1.4 | 1.4 | 1.9 | 12.2 | 51.9 | 30.9 |
| 451084 | 14-30 | .8 | 1.7 | 1.4 | 1.7 | 9.4 | 42.3 | 42.6 |
| 451085 | 30-60 | 1.0 | 2.1 | 1.7 | 1.9 | 10.0 | 31.7 | 51.6 |
| 451086 | 60-90 | .7 | 1.3 | .9 | .9 | 1.9 | 48.4 | 46.0 |
| Randall clay: | | | | | | | | |
| 451046 | 0- 1 | .2 | .3 | .1 | .6 | 8.7 | 52.7 | 37.3 |
| 451047 | 1-10 | .0 | .1 | .1 | .4 | 6.6 | 41.6 | 51.3 |
| 451048 | 10-30 | .5 | .5 | .2 | .5 | 5.1 | 38.8 | 54.4 |
| 451049 | 30-60 | .1 | .2 | .1 | .3 | 3.7 | 38.6 | 57.0 |
| 451050 | 60+ | .0 | .0 | .1 | .3 | 1.7 | 34.1 | 63.7 |

## SUMMARY

Tillman County is in southwestern Oklahoma. It includes an area of 900 square miles and is part of a smooth plain sloping slightly toward the south.

The population, according to the 1930 census, is 24,390, of which 19,822 are classed as rural.

The average length of the frost-free season is 226 days. The average annual precipitation is 26.95 inches, the greater part of which falls during the growing season.

Of the total area of the county, 94.3 percent is in farms, and the farms average 188.8 acres in size. Of the 2,763 farms reported in 1930, 1,673 were operated by tenants, 1,080 by owners and part owners, and 10 by managers.

Twenty soil types, and three phases of types, in addition to rough stony land, dune sand, and river wash, have been identified and mapped. The soils are classified, on the basis of certain common soil characteristics, in two major soil groups, namely, the sandy soils group and the clay loam soils group. Soils of the clay loam group occur only in the northeastern half of the county. They have very dark grayish-brown or chocolate-brown friable surface soils that grade, at a depth of 6 inches, into brown compact silty clay subsoils. These continue downward to a depth of 18 inches and grade into yellowish-brown silty clay that contains lime in concretions and in finely disseminated form. The sandy soil group embraces the remainder, or western half, of the county and includes soils with brown or chocolate-brown friable sandy surface soils extending to a depth ranging from 6 to 12 inches, where they merge with reddish-brown friable subsoils, which extend to a depth of 36 or more inches and are underlain by reddish-brown friable sandy clay material. The soils of the sandy soil group differ from the soils of the clay loam group in that the surface soils and subsoils of the sandy soil group consist of more friable materials which extend to considerable depth below the surface.

The amount of available moisture in the soil is the limiting factor in crop production. It is greatest in the soils of the sandy group, which have friable surface soils and subsoils that allow the absorption of large quantities of rainfall. The principal crops—cotton, wheat, oats, corn, barley, kafir, alfalfa, and rye—are grown most advantageously on the soils of this group, and some of these crops, as alfalfa and corn, are grown almost exclusively on these soils. The compact clay subsoils of the clay loam soils allow a much smaller amount of the rainfall to be absorbed, as compared with the soils of the sandy group, and most crops cannot be grown so advantageously on the soils of the clay loam group as on the soils of the sandy group. The available moisture supply in the clay loam soil group is stored mainly in the surface soil, and crops must be grown which can make immediate use of moisture when it is being supplied from rains. Such crops include wheat, oats, and barley, which make most of their growth in late fall and spring when the moisture in the surface soil is most plentiful.

Cotton or wheat are the predominant crops in most parts of Tillman County, and these crops do not lend themselves to the expansion of the agricultural industry, other than that of growing cash crops. Crops must be of the kind that can be readily converted into feed for

livestock before other lines of agricultural industry can be followed. However, as long as the production of cotton and wheat is profitable, these will continue to be the leading crops. Livestock raising is developed only in certain sections, for the purpose of making use of the available feed. In the northeastern half, which is occupied by the clay loam soils, the feed that is available through pasturage of the wheat fields and the uncultivated lands tends to develop the livestock industry. In the western half, comprised of the sandy soils, the feed made available by growing alfalfa and other forage crops encourages the raising of livestock.

# Accessibility Statement

This document is not accessible by screen-reader software. The U.S. Department of Agriculture is committed to making its electronic and information technologies accessible to individuals with disabilities by meeting or exceeding the requirements of Section 508 of the Rehabilitation Act (29 U.S.C. 794d), as amended in 1998. Section 508 is a federal law that requires agencies to provide individuals with disabilities equal access to electronic information and data comparable to those who do not have disabilities, unless an undue burden would be imposed on the agency. The Section 508 standards are the technical requirements and criteria that are used to measure conformance within this law. More information on Section 508 and the technical standards can be found at www.section508.gov.

If you require assistance or wish to report an issue related to the accessibility of any content on this website, please email Section508@oc.usda.gov. If applicable, please include the web address or URL and the specific problems you have encountered. You may also contact a representative from the USDA Section 508 Coordination Team.

**Nondiscrimination Statement**

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the

Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at http://www.ascr.usda.gov/complaint_filing_cust.html and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by:

(1) mail: U.S. Department of Agriculture
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410;

(2) fax: (202) 690-7442; or

(3) email: program.intake@usda.gov.

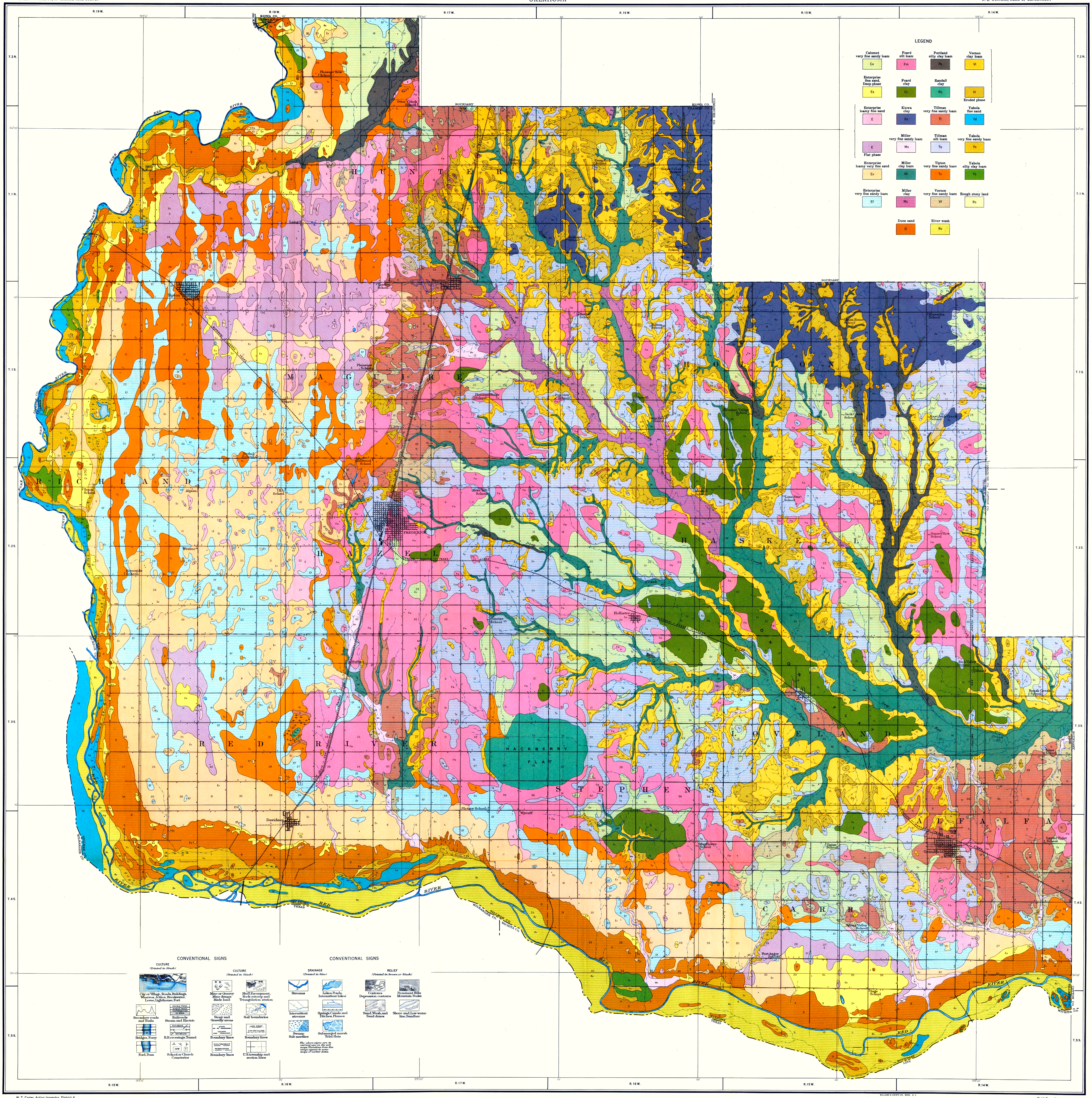
USDA is an equal opportunity provider, employer, and lender.

U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF CHEMISTRY AND SOILS
HENRY G. KNIGHT, CHIEF
A. G. McCALL, CHIEF, SOIL INVESTIGATIONS
CURTIS F. MARBUT, IN CHARGE SOIL SURVEY

# SOIL MAP

TILLMAN COUNTY
OKLAHOMA

OKLAHOMA AGRICULTURAL EXPERIMENT STATION
C. P. BLACKWELL, DIRECTOR
AGRONOMY DEPARTMENT
N. E. WINTERS, HEAD OF DEPARTMENT




W. T. Carter, Acting Inspector, District 4.
Soils surveyed by A. W. Goke, in charge, and E. G. Fitzpatrick,
U. S. Department of Agriculture, and W. C. Boatright, Oklahoma
Agricultural Experiment Station.

Field Operations
Bureau of Chemistry and Soils
1930